407-441

HOUSATONIC RIVER BASIN

SEYMOUR, CONNECTICUT

MIDDLE RESERVOIR DAM
CT 00590

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

APRIL, 1980

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

MAY 13 1980

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Middle Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, The Ansonia-Derby Water Company, Ansonia, Connecticut 06401.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Housatonic River Basin
Seymour, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam of the Middle Reservoir is a concrete and masonry structure. It is approximately 300 feet long, 27 feet high and has an average top width of 8 feet. Based on visual inspection and past operational performance, the dam is judged to be in FAIR condition. The dam is classified as SMALL in size and a SIGNIFICANT hazard potential. The test flood for this dam is ½ the PMF.

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HOUSATONIC RIVER BASIN

SEYMOUR, CONNECTICUT

MIDDLE RESERVOIR DAM

CT 00590

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

Identification No.:	CT 00590
Name of Dam:	Middle Reservoir Dam
Town:	Seymour
County and State:	New Haven, Connecticut
Stream:	Beaver Brook
Date of Inspection:	November 16, 1979

BRIEF ASSESSMENT

The dam of the Middle Reservoir is a concrete and masonry structure. It is approximately 300 feet long, 27 feet high and has an average top width of 8 feet. The Middle Reservoir Dam was probably constructed in the late 1800s with subsequent improvements in 1905. The Ansonia - Derby Water Company presently owns and operates the dam and appurtenant structures.

Based on visual inspection and past operational performance, the dam is judged to be in FAIR condition. Seepage and vegetation was noted on the downstream face and the crest is chipped and spalled due to an unfinished rehabilitation project.

The dam is classified as SMALL in size and a SIGNIFICANT hazard potential structure in accordance with the Recommended Guidelines for Safety Inspection of Dams, established by the Corps of Engineers. The impoundment storage at the top of the dam is 36 ac.-ft. and the maximum height of the dam is 27 feet. Failure of the dam would result in the loss of a few lives and damage to a fluoridation house.

The test flood for this dam is 1/2 the Probable Maximum Flood (PMF). The test flood has an inflow equal to 770 cfs and an outflow discharge equal to 765 cfs with a stillwater elevation of 269.4 which will overtop the dam by 1.0 feet.

These values represent no flood storage in the upstream Beaver Lake. If use is made of the storage capacity of Beaver Lake, the flood inflow to the Middle Reservoir can be greatly reduced. The dam was not overtopped in the 1955 flood because Beaver Lake was low.

The maximum outflow capacity of the spillways under a stillwater condition is 132 cfs, which is 17 percent of the test flood.

It is recommended that the following items be studied further: The downstream leakage, the upstream face, the spillway capacity, the removal of trees on the embankment below the dam, and the completion of the 1975 crest rehabilitation program.

The following remedial measures should be taken: The removal of vegetation from the face and crest of the dam, repointing of joints, monitoring of seepage on the downstream face, development of a downstream warning plan and an annual inspection program.

Recommendations and remedial measures that should be implemented within one year of receipt of this Phase I Inspection Report are further described in Section 7.

JAMES P. PURCELL ASSOCIATES, INC.

Sudhir A. Shah, P.E.
Vice-President
Connecticut P.E. No. 8012

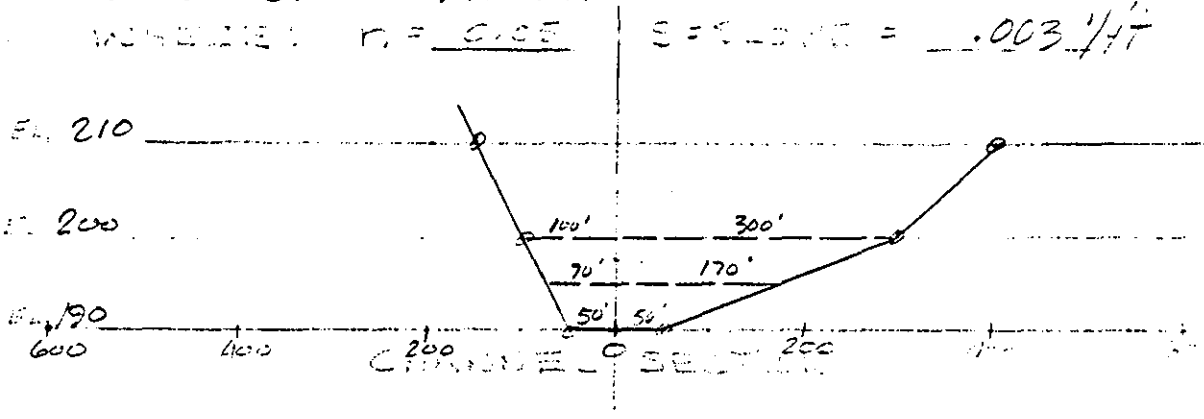
CHKD BY ERJ DATE 11/15/80

LINE OF DAM: Main Levee

SECTION LOCATION: 1000 CENTERLINE STA.

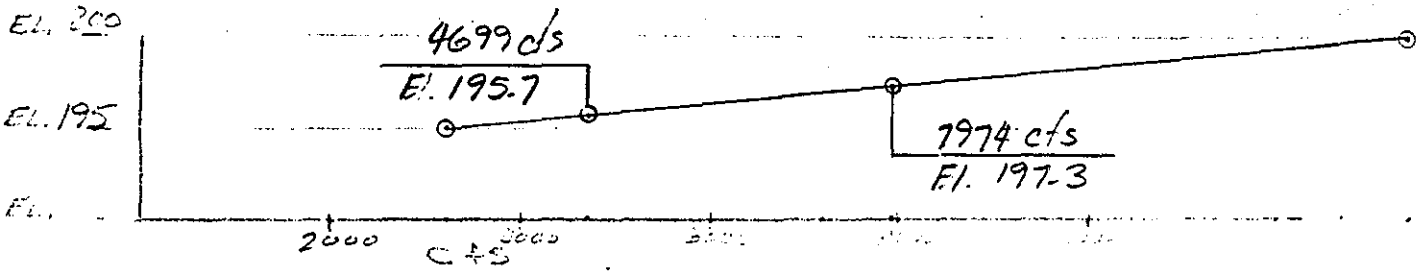
USING: $Q = 1.486/n \, A R^{2/3} S^{1/2}$

ROUGHNESS: n = 0.035 SLOPE = .003 ft/ft



Q_{PF} = 7974 cfs STORAGE (S) = 33 Ac-ft

ELEV	AREA	WP	R	$R^{2/3}$	$S^{1/2}$	$1.486/n$	Q	INTERVAL
195	850	240	3.54	2.32	.055	29.72	3223	5'
200	2450	400	6.12	3.35	.055	29.72	13416	5'
						29.72		



$V_1 = \frac{5+7.3}{2} \times (170+310 \times 800 \div 43,560) \frac{1}{2}$ = 13.6 Ac-ft

$Q_{P2} = Q_{PF} (1 - V/S)$ = 4699 cfs

$V_2 = \frac{5+5.7}{2} \times \left(\frac{170+250}{2} \times 800 \div 43560\right) \frac{1}{2}$ = 10.3 Ac-ft V_{AD} 11.9 Ac-ft

$Q_{PE} = Q_{PF} (1 - V_{AD}/S)$ = 5084 cfs

STAGE DISCHARGE: 5084 cfs ELEV 195.9 OR A D = 5.9

WIDTH OF CHANNEL/RIVER SECTION 1000 FT

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation. However, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there by any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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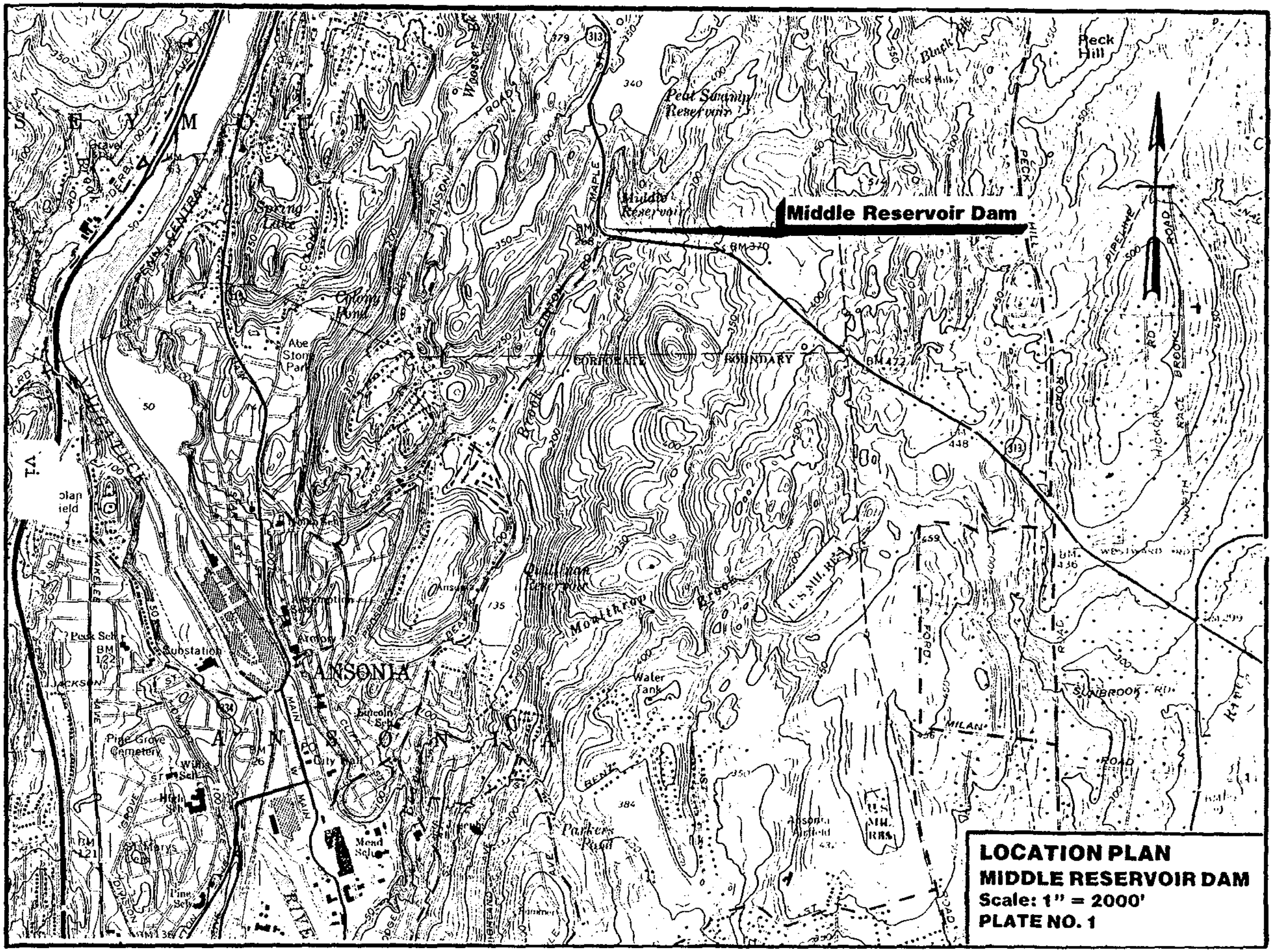


LOCATION PLAN
MIDDLE RESERVOIR DAM
Scale: 1" = 2000'
PLATE NO. 1

NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

NAME OF DAM: MIDDLE RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority: Public Law 92-367, August 8, 1972, authorized the Secretary of the Army through the Corps of Engineers to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. James P. Purcell Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to James P. Purcell Associates, Inc., under a letter from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0002 has been assigned by the Corps of Engineers for this work.

b. Purpose:

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and prepare the States to initiate quickly, effective dam safety programs for non-Federal dams.

3. To update, verify and complete the National Inventory of Dams.

1.2 Description of the Project

a. Location:

Middle Reservoir Dam is located in the Town of Seymour at the intersection of Clinton Road and Route 313 (see Plate No. 1). The dam impounds water from Beaver Brook and is located approximately 11,500 feet above the confluence with the Naugatuck River, and 5,000 feet upstream of the Quillian Reservoir Dam.

The Beaver Lake Dam (also known as Peat Swamp Reservoir) is located 1700 feet upstream of the Middle Reservoir Dam. The Middle Reservoir is situated in a north/south direction, with the dam at the south end. The latitude is 41°-21'-56" and the longitude is 73°-03'-41".

All elevations used in this report are based on the National Geodetic Vertical Datum (NGVD).

b. Description of Dam and Appurtenances:

Middle Reservoir Dam is a concrete and stone masonry structure, approximately 300 feet long, 27 feet high, and with an average top width of 8 feet. The stone masonry downstream face is battered; the batter varies from 1H:5V to 1H:7V. In plan, the face is arched with a radius of approximately 160 feet. The downstream face is partially covered below the dam's west crest with an earth embankment at a slope of approximately 2H:1V. This embankment is heavily vegetated with large evergreen trees. The upstream face is concrete and is stepped in cross section.

The primary spillway is located in the center of the dam. It is 28 feet long, has a concrete invert at elevation 267.4 and is 8.5 feet wide. A 12 foot long auxiliary spillway is located at the east abutment at an elevation of 266.9.

The outlet works consist of a 30 inch cast iron intake pipe into the wet well of the gate house, which is located on the dam's west crest and is equipped with two hand wheel operated gate valves. One valve controls the flow into the 30 inch intake pipe and the other valve controls the discharge from the wet well to a 24 inch pipe. The 24 inch discharge pipe carries the flow by gravity through the dam to a fluoridation house downstream of the dam and then to the water distribution system.

An 8 inch blowoff pipe extends through the base of the dam and outlets to the spillway discharge channel below the dam. This blowoff is regulated by a control hydrant which is operated once a year.

The Middle Reservoir Dam impounds water from Beaver Lake (also known as Peat Swamp Reservoir), located 1700 feet upstream, via a pipe and Beaver Brook.

c. Size Classification:

The size classification of this dam is SMALL as per the criteria set forth in the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers. The impoundment storage at the top of the dam is 36 ac.-ft. (range 50 to 1000 ac.-ft.) and the maximum height of the dam is 27 feet (within the range

of 25 to 40 feet). The size classification is based on both the height and storage criteria.

d. Hazard Classification:

The hazard classification of this dam is SIGNIFICANT as per the criteria set forth in the Recommended Guidelines for Safety Inspection of Dams, by the Corps of Engineers. The dam is located upstream of the Quillinan Reservoir, Route 313, and a fluoridation house where failure discharge may cause the loss of a few lives, at the fluoridation house, and cause damage due to high velocity impact from debris and flooding. The estimated water depth due to the assumed dam failure may range from 27 feet at the dam to 3 feet, 5000 feet downstream at the Quillinan Reservoir.

Loss of the Middle Reservoir and the fluoridation house would impact a hardship on the Water Company.

e. Ownership:

The Middle Reservoir Dam is presently owned and maintained by the Ansonia - Derby Water Company, 230 Beaver Street, Ansonia, Connecticut, 06401.

f. Operator:

The operator and caretaker of the dam is:

Mr. Wilbur Clark
Ansonia - Derby Water Company
230 Beaver Street
Ansonia, CT 06401
Telephone: (203) 735-1888 (office)
(203) 734-6641 (home)

g. Purpose:

Middle Reservoir Dam impounds water from Beaver Brook and is used for supplying water to the distribution system of the Ansonia - Derby Water Company.

h. Design and Construction History:

The Middle Reservoir Dam was probably constructed in the late 1800s. The original dam was constructed only of grouted stone masonry. In 1905, improvements to the dam were made; this involved placement of concrete against the upstream face, probably an attempt to increase overturning stability of dam section and to

limit leakage. Subsequent to the 1905 improvements, the east crest of the dam has been raised approximately 1.5 feet by the addition of a masonry and concrete wall, and the auxiliary spillway constructed. A crest rehabilitation program was undertaken in about 1975, including mechanical removal of spalled concrete, but was not completed leaving the crest in a severely spalled condition.

i. Normal Operational Procedures:

Water is withdrawn from the reservoir into the gate house wet well via the 30 inch pipe and continues to the distribution system via the 24 inch pipe.

1.3 Pertinent Data

a. Drainage Area:

The Middle Reservoir drainage basin is generally triangular in shape with a length of 1.5 miles and an average width of 0.45 miles resulting in a total drainage area of .68 square miles (see drainage basin map in Appendix D). The topography is generally moderate to steep terrain, with elevations ranging from a high of 550 feet to a low of 266.9 feet at the auxiliary spillway crest. Stream and basin slopes are steep, 8 percent and 15 percent respectively. The reservoir has a normal surface area of 3.0 acres which is 0.7 percent of the watershed. The upstream Beaver Lake has a normal surface area of 77 acres which is 18 percent of the watershed. Eighty-eight percent of the watershed drains into Beaver Lake.

b. Discharge at Dam Site:

There is no specific discharge records available for this dam. Listed below are calculated discharge values for the spillway and outlet works (24 inch pipe and 8 inch blowoff pipe):

1. Outlet works: A 24 inch pipe with an intake at elevation 248.2 and a discharge capacity of 65 cfs at elevation 267.4. An 8 inch blowoff with an intake at approximately 234 and a discharge capacity of 10 cfs at elevation 267.4.

2. Maximum known flood at dam site: Calculated to have been approximately 40 cfs based on a reported flow of 3 to 4 inches over the primary spillway. Flood flows have been mitigated by the upstream Beaver Lake.

3. Spillway capacity at top of dam: 78 cfs (primary) and 54 cfs (auxiliary) at elevation 268.4.

4. Spillway capacity at test flood elevation: 340 cfs at elevation 269.4.

5. Gated outlet capacity at normal pool elevation: 64 cfs (24 inch) and 10 cfs (8 inch) at elevation 266.9.

6. Gated outlet capacity at test flood elevation: 69 cfs (24 inch) and 10 cfs (8 inch) at elevation 269.4.

7. Gated outlet capacity at top of dam elevation: 66 cfs (24 inch) and 10 cfs (8 inch) at elevation 268.4.

8. Total project discharge at top of dam: 208 cfs at elevation 268.4.

9. Total project discharge at test flood level: 844 cfs at elevation 269.4.

c. **Elevation (Feet above NGVD):**

1.	Stream bed at toe of dam	241.4
2.	Bottom of cutoff	226.4
3.	Maximum tailwater	N/A
4.	Recreation pool	N/A
5.	Full flood control pool	N/A
6.	Spillway crest (normal pool)	267.4 (primary) 266.9 (auxiliary)
7.	Design surcharge (Original Design)	Unknown
8.	Top of dam	268.4 (west) 269.5 (east)
9.	Test flood level	269.4

d. **Reservoir (Length in feet)**

1.	Normal pool	750
2.	Flood control pool	N/A
3.	Spillway crest pool	750
4.	Top of dam	800

5.	Test flood pool	900

e. Storage (acre-feet)

1.	Normal pool	33
2.	Flood control pool	N/A
3.	Spillway crest pool (primary)	33
4.	Top of dam	36
5.	Test flood pool	40

f. Reservoir Surface (acres)

1.	Normal pool	3.0
2.	Flood control pool	N/A
3.	Spillway crest (primary)	3.0
4.	Test flood pool	3.8
5.	Top of dam	3.5

g. Dam

1.	Type	Stone masonry and concrete
2.	Length	300 feet
3.	Height	27 feet
4.	Top width	8 feet
5.	Side slopes	Upstream - stepped Downstream - 1H:5V to 1H:7V
6.	Zoning	Unknown
7.	Impervious core	Masonry

8.	Cutoff	Concrete
9.	Grout curtain	Unknown
10.	Other	— — —

h. Diversion and Regulating Tunnel — **N/A**

i. Spillway

1.	Type	Overflow, broad crested uncontrolled weirs
2.	Length of weir	29.0 feet (primary) 12.0 feet (auxiliary)
3.	Crest elevation	267.4 (primary) 266.9 (auxiliary)
4.	Gates	None
5.	U/S Channel	Natural bed
6.	D/S Channel (primary spillway)	Overgrown gravel and rock channel
	D/S Channel (auxiliary spillway)	Riprap and rock, joins primary spillway channel below dam.

j. Regulating Outlets

Refer to Paragraph 1.2b - "Description of Dam and Appurtenances" for description of Outlet Works.

1.	Inverts and size	24 inch pipe - 248.2 feet 8 inch pipe - 234+/— feet
2.	Description	Cast iron pipes

3.	Control Mechanisms	24 inch — hand operated gear mechanisms with masonry gate house 8 inch — control hydrant below dam

SECTION 2

ENGINEERING DATA

2.1 Design

There are limited available records presenting design information for the construction of the Middle Reservoir Dam. A 1905 plan, cross sections, elevation of the dam, and an undated sketch of the outlet works have been included in Appendix B of this report.

Other data concerning the dam was destroyed during past flooding of the Water Company offices.

2.2 Construction

There are no available records of the construction of this dam.

2.3 Operation

No formal records of operation are kept for this facility.

2.4 Evaluation

a. **Availability:** The information noted above for this facility is available in the files of the Department of Environmental Protection, Water and Related Resources Unit, Dam Safety Engineers, State Office Building, Hartford, Connecticut, and the Ansonia - Derby Water Company, Ansonia, Connecticut.

b. **Adequacy:** The lack of indepth engineering did not allow a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data alone, but is based primarily on the visual inspection, the dam's past performance, and sound engineering judgment.

c. **Validity:** The validity of the limited information available could not be verified.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General: The visual inspection of the Middle Reservoir Dam was conducted on November 16, 1979 and a copy of the visual inspection check list is contained in Appendix A of this report.

The following procedure was used:

1. Inspection of the upstream area of the reservoir which is impounded by the dam.

2. Visual inspection of the face and top of the dam and spillways for cracks, loose stones, leakage, etc.

3. Inspection of the outlet works and other appurtenances as to their existence, location, and operability.

4. Review of procedures that could be utilized in the event of an emergency situation.

5. A check of the downstream area for seepage, piping, boils or other indications of abnormal conditions. The downstream hazard potential in the event of dam failure was investigated.

6. Photographs of the general area of the dam and of specific items of note were taken and are included in Appendix C of this report.

Before the inspection, the available existing data and aerial photographs were studied and reviewed.

b. Dam

1. Crest: The top of the dam is constructed of granite stones with a concrete cap and shows no evidence of settlement or misalignment. The dam's crest has a low 6 inch wall along the upstream edge (Photos C-3, C-12). The dam's east crest (labeled wingwall on the record drawing) has a 30 inch concrete capped stone wall along the downstream edge (Photo C-4). Grass is growing on the west crest except in the immediate area of the spillway. In this area and the entire east crest, spalling concrete was mechanically

removed in about 1975 as part of a crest rehabilitation project. The project has not been completed and further spalling has occurred. The top is approximately 8 feet wide.

2. Upstream Face: The upstream face of the dam is stepped concrete over the original masonry. The face above the water level on the day of the inspection, 12 inches below the dam's west crest, is also spalled and chipped.

3. Downstream Face: The downstream face is stone masonry with a slope varying from 1H:5V to 1H:7V. See Appendix B for sections through the dam. Considerable vegetative growth exists on the face including grass, vines and small shrubs (Photo C-1, C-2, C-9). Mortar is missing from most of the joints creating voids and there is leakage from several joints (Photo C-7) and from the ground at the toe (Photo C-8). Trees are growing on the earthen embankment below the western side of the dam (Photo C-12).

c. Appurtenant Structures

1. Primary Spillway: The primary spillway is a 29 foot long and 8 foot wide broad crested weir located in the central portion of the dam (Photo C-1, C-2). It is constructed of a concrete cap over stone masonry, and is also chipped and spalled (Photos C-3 and C-4). Water was not flowing over this spillway at the time of the inspection.

2. Auxiliary Spillway: The auxiliary spillway is a 12 foot long opening in the top of dam at the east abutment. The concrete crest of the spillway is at the same level as the beginning of the discharge channel (Photo C-5). A slight flow was occurring from this spillway which is approximately 6 inches lower than the primary spillway.

3. 24 Inch Pipe: A 24 inch pipe extends from the gate house, through the dam, and continues downstream approximately 700 feet to a fluoridation house and on to the water distribution system. The pipe is controlled at the gate house by a 24 inch gate valve which is usually open. This valve was reportedly operational.

4. 6 Inch Drain: Record drawings indicate a 6 inch drain for the gate house, which discharges below the dam. The control valve is located and operated from inside the gate house. The discharge point could not be determined and it is not known if the valve is operable.

5. 8 Inch Blowoff: An 8 inch low level blowoff extends from an intake upstream of the dam, through the base of the dam, to an outlet below the dam, at the discharge channel. The blowoff is controlled by a hydrant and is reportedly exercised once a year.

6. Gate House: The gate house is a brick and concrete structure and is located on the dam's west crest (Photo C-12). The house is generally in good condition with a few minor cracks in the concrete. A single 30 inch pipe admits water into the wet well and is controlled by a 30 inch gate valve which is reportedly operational (Photo C-11).

d. **Reservoir Area:** The reservoir is formed by the flooding of a portion of the Beaver Brook Valley. The sides of the forested valley have gentle slopes bordering the reservoir. No geologic features were detected that could be expected to adversely affect the dam or its appurtenant structures.

Trespassing on the dam is not permitted.

The Beaver Lake (Peat Swamp Reservoir) is located approximately 1700 feet upstream of the dam and failure of this upstream dam would create a potential hazard on the Middle Reservoir Dam.

e. **Downstream Channel:** The downstream channel is a meandering stream in a natural condition. The discharge channel for the auxiliary spillway (Photo C-6) is a small rock channel which joins the primary spillway channel below the dam. There is a 46 inch wide by 60 inch high concrete box culvert below Route 313 (Photo C-14) approximately 100 feet below the dam. The roadway is at elevation 260+/— or approximately 27 feet above the streambed. A small pond and dam are approximately 400 feet below the Middle Reservoir Dam.

There was seepage from the ground approximately 50 feet below the west abutment of the Middle Reservoir Dam (Photo C-10) at the toe of the highway embankment.

3.2 Evaluation

Based on the visual inspection, the Middle Reservoir Dam appears to be in fair condition overall, and there were no major areas of distress noted. Specific areas of concern that were noted are:

The presence of leakage and vegetative growth on the downstream face and embankment.

The spalling and chipped condition of the crest and spillway due to the unfinished rehabilitation project.

The missing mortar and voids between stones on the downstream face.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

The Middle Reservoir is a surface water supply storage facility for the Ansonia - Derby Water Company. Water flows by gravity from the gate house, located on the dam, to the fluoridation house, located downstream of the dam, through a 24 inch cast iron pipe. Water is then supplied to the water distribution system. The 8 inch blowoff is operated annually.

4.2 Maintenance of the Dam

There is no regular maintenance schedule for this dam. An uncompleted rehabilitation project has resulted in the present chipped and spalled condition of the crest and spillway.

4.3 Maintenance of the Operating Facilities

No regular maintenance of the gate house valves was reported. The lift mechanisms appear in good working condition. The control hydrant used to discharge water from the 8 inch blowoff is operated on an annual basis.

4.4 Description of Any Warning System in Effect

No formal emergency or contingency plan is in effect to reduce or minimize downstream damage in emergency situations.

4.5 Evaluation

To insure the safety of the residents downstream a regular inspection and maintenance program should be developed and implemented.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Middle Reservoir Dam creates an impoundment with a total storage capacity of 33 ac.-ft. at elevation 267.4, the primary spillway crest elevation. Each foot of depth in the reservoir above the spillway crest can accommodate approximately 3 ac.-ft. The primary spillway is a 29 foot long by 8 foot wide broad crested uncontrolled weir. The auxiliary spillway is a 12 foot long opening in the crest at the east abutment. 88 percent of the drainage area drains to the upstream Beaver Lake. Stream and basin slopes are steep, 8 percent and 15 percent, respectively.

5.2 Design Data

a. No specific design data is available for this watershed or the structures of the Middle Reservoir Dam. In lieu of existing design information, USGS topographic maps (scale 1"=2000') were utilized to develop hydrologic parameters such as drainage area, basin length, time of concentration, and other runoff characteristics. Elevation-storage relations for the reservoir were approximated. Reservoir surface area and surcharge storage were computed using the USGS maps. Some of the pertinent hydraulic design data was obtained and/or confirmed by actual field measurements at the time of the visual inspection.

b. Outflow values (routing procedures) and dam overtopping analyses were computed in accordance with the guidelines developed by the Corps of Engineers. Judgment was used in calculating final values outlined in this report, which are quite approximate and should not be considered a substitute for actual detailed analysis.

5.3 Experience Data

Historical data for recorded discharges is not available for this dam. The maximum discharge over the spillways to date was calculated to be approximately 40 cfs corresponding to a water level of 3 to 4 inches over the primary spillway.

The existence of Beaver Lake (Peat Swamp Reservoir) 1700 feet upstream of the dam has a pronounced effect on flood flows to the Middle Reservoir. During the 1955 flood, the water level in Beaver Lake was low and outflow was substantially curtailed, and reportedly, the Middle Reservoir Dam was not overtopped.

5.4 Test Flood Analysis

Recommended guidelines for the Safety Inspection of Dams by the Corps of Engineers were used for the selection of the "Test Flood". This dam is classified as a SIGNIFICANT hazard and SMALL size structure. Guidelines indicate that a range of the 100 year flood to 1/2 times the Probable Maximum Flood (PMF) be used as the "Test Flood" for these classifications. A test flood of 1/2 PMF was chosen to yield conservative values in light of the approximate nature of the analysis. The watershed has a total area of .68 square miles. Snyder's lag was calculated to be 2.25 hours and a Snyder peaking coefficient of 0.625 was used. The 200 square mile - 24 hour Probable Maximum Precipitation (PMP) is 22 inches. The flood hydrograph package, HEC-1 computer program developed by the Corps of Engineers was utilized to develop the inflow hydrograph, route the flood through the reservoir, and for the dam overtopping analysis. A test flood inflow equal to 1/2 PMF was calculated to be 770 cfs.

This test flood analysis assumes that the outlet works are closed and that Beaver Lake (Peat Swamp Reservoir) is full and is providing no reduction in flood flows.

The spillway capacity is hydraulically inadequate to pass the test flood (1/2 PMF) and overtopping of the dam will occur. The maximum outflow capacity of the spillways without overtopping the dam is 132 cfs. This corresponds to approximately 17 percent of the test flood and a storage above the primary spillway level of 3 ac.-ft. The maximum outflow discharge value for the test flood is 765 cfs corresponding to a depth of flow over the top of the dam of 1.0 foot and a storage above the spillway level of 7 ac.-ft. A spillway rating curve, an outlet rating curve, and a reservoir surface area-capacity curve, are included in Appendix D of this report.

At the primary spillway elevation of 267.4, the capacity of the 8 inch outlet structure is 10 cfs, and 65 cfs can be withdrawn via the 24 inch supply main. It will require approximately 1/2 hour to lower the water level the first foot assuming a water surface area of 3 acres, normal inflow conditions, and use of the outlet works to regulate the water level for expected inflows.

5.5 Dam Failure Analysis

This dam is classified as a significant hazard structure. Failure discharge can cause damage due to high velocities, impact from debris, and flooding to the fluoridation house along the downstream channel and two roads.

The calculated dam failure discharge is 8000 cfs at a pool level equal to the top of the dam. At this level the pre-failure flow in the downstream channel will be equal to the full spillway's capacity of 132 cfs corresponding to a depth of flow of less than 1 foot. Failure will produce a water surface level approximately 27 feet immediately downstream from the dam due to the Route 313 embankment. This roadway is approximately at elevation 260 and the embankment is assumed to wash out in the event of a dam failure. The fluoridation house located approximately 750 feet downstream

of the dam may be inundated by 2 to 3 feet of water. The failure discharge will effect downstream areas for a distance of 5000 feet from the dam.

At this distance, the water surface level will be approximately 3 feet above normal observations as it enters the Quillian Reservoir. Beyond 5000 feet, the effects of the failure discharge will be reduced as it enters the Quillian Reservoir. Water surface elevations due to the failure of the dam are listed in Appendix D. Probable consequences including the prime impact areas are also listed in Appendix D.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observation

The visual inspection revealed no signs of major physical distress in the structure. However, leakage was noted on the downstream face and below the dam.

6.2 Design and Construction Data

There is insufficient design and construction data to permit a formal evaluation of stability.

6.3 Post-Construction Changes

The stepped concrete wall was placed against the upstream face in 1905.

The east crest was modified by the creation of a 1.5 foot stone masonry and concrete wall on the top of the crest, and the auxiliary spillway was constructed subsequent to 1905.

An uncompleted 1975 crest rehabilitation project has resulted in the spalled condition of the crest.

6.4 Seismic Stability

The dam is in Seismic Zone 1 and hence does not require evaluation for seismic stability according to the Corps of Engineers Recommended Guidelines.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. **Condition:** Based on the visual inspection, past performance and hydraulic/hydrologic evaluation, the Middle Reservoir Dam and appurtenances are judged to be genarally in FAIR condition. Items of concern that should be addressed as a result of this inspection are listed in Section 7.2 and 7.3.

b. **Adequacy of Information:** The limited engineering data did not allow for a definitive review. Therefore, the adequacy of the dam is based on visual inspection, past performance history, and engineering judgment.

c. **Urgency:** The recommendations and remedial measures described below should be implemented by the owner within one year after receipt of this Phase I Inspection Report.

7.2 Recommendations

It is recommended that the owner engage a qualified registered engineer to carry out the following actions and that his recommendations be implemented.

a. A detailed hydrologic/hydraulic investigation to determine the need and means of increasing the discharge capacity of the project.

b. A plan be developed for the removal of the trees on the embankment below the western side of the dam to prevent piping.

c. The upstream face be visually inspected.

d. The crest rehabilitation project should be completed.

7.3 Remedial Measures

a. Operational and Maintenance Procedures

1. The vegetation should be removed from the joints and the joints repointed on the downstream face of the dam.

2. The remaining vegetation should be removed from the crest.

3. The seepage on the downstream face should be monitored to note any change from the existing conditions.

4. Insure the operability of all valves for the outlet works.

5. The cracks in the concrete on the gate house should be repaired.

6. Develop a downstream warning and surveillance plan, including round-the-clock monitoring during heavy precipitation.

7. Institute a program of annual periodic technical inspection.

7.4 Alternatives

None.

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Middle Reservoir Dam

DATE November 16, 1979

TIME 1:00 - 2:30 P.M.

WEATHER Clear

W.S. ELEV. _____ U.S. ____ DN.S.

PARTY:

1. R. Johnston, JPPA
2. R. Lyon, JPPA
3. J. Chastanet, CWDD
4. _____
5. _____
6. B. Clark, Ansonia - Derby Water Company
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydraulics	R. Johnston	
2.	Structural	R. Lyon	
3.	Geotechnical	J. Chastanet	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam DATE November 16, 1979

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation 268.4	Fair - Spalled concrete removed in 1975± but not replaced.
Current Pool Elevation 266.9	Crest of auxiliary spillway.
Maximum Impoundment to Date	Approximately 4 inches over primary spillway.
Surface Cracks	Cracks in grout and joints.
Pavement Condition	N/A
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Not permitted
Vegetation on Slopes	Considerable growth on dam.
Sloughing or Erosion of Slopes or Abutments	Minor deterioration of concrete joints.
Rock Slope Protection - Riprap Failures	N/A
Unusual Movement or Cracking at or near Toes	None observed
Unusual Embankment or Downstream Seepage	Seepage on downstream face and from ground below dam.
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam DATE November 16, 1979

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Entire lake bed - under water.
b. Intake Structures	
24 inch pipe and 6 inch drain	Water enters the gate house wet well via a 30 inch pipe controlled by a gate valve.
8 inch blowoff	Record drawing indicates a free access pipe inlet.

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam DATE November 16, 1979

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Good
Condition of Joints	Good
Spalling	Minor
Visible Reinforcing	None observed
Rusting or Staining of Concrete	None observed
Any Seepage or Efflorescence	None observed
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	None observed
Cracks	Minor on exterior concrete.
Rusting or Corrosion of Steel	None observed
b. Mechanical and Electrical	
Air Vents	4 inch vent into gate house from 24 inch pipe.
Float Wells	N/A
Crane Hoist	N/A
Elevator	N/A
Hydraulic System	N/A
Service Gates	See Intake Structures
Emergency Gates	See Intake Structures
Lightning Protection System	None observed
Emergency Power System	N/A
Wiring and Lighting System in Gate Chamber	None observed

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam DATE November 16, 1979

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
24 Inch Pipe	A 24 inch sluice gate in the gate house controls flow into the 24 inch pipe. The 24 inch pipe extends through the dam and runs approximately 750 feet to a fluoridation house. The pipe then continues to the water distribution system.
6 Inch Drain	A 6 inch gate valve in the gate house controls flow into the 6 inch drain. The 6 inch drain extends through and discharges below the dam.
8 Inch Blowoff	The 8 inch pipe extends from the inlet upstream of the dam, through the embankment, and continues to a control hydrant downstream of the dam.

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam DATE November 16, 1979

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
24 Inch Pipe	The outlet for this pipe is the water distribution system. Water can also be blown off at the fluoridation house.
6 Inch Drain	The outlet for the 6 inch drain could not be determined.
8 Inch Blowoff	An 8 inch pipe extends from the control hydrant to the spillway discharge channel below the dam. This system is operated annually.

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam DATE November 16, 1979

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	PRIMARY SPILLWAY
a. Approach Channel	Reservoir Bed - Under water
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir	
General Condition of Concrete	Fair to Good
Rust or Staining	None Observed
Spalling	Minor
Any Visible Reinforcing	None Observed
Any Seepage or Efflorescence	None Observed
Drain Holes	None Observed
c. Discharge Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None Observed
Trees Overhanging Channel	Yes
Floor of Channel	Overgrown and Marshy
Other Obstructions	A 46 inch wide by 60 inch high concrete box culvert under Route 313, approximately 100 feet below the dam.

INSPECTION CHECK LIST

ROJECT Middle Reservoir Dam DATE November 16, 1979

ROJECT FEATURE _____ NAME _____

SCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
TLET WORKS - SPILLWAY WEIR, PROACH AND DISCHARGE CHANNELS	AUXILIARY SPILLWAY
Approach Channel	Reservoir Bed - Underwater
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
Weir and Training Walls	
General Condition of Concrete	Good
Rust or Staining	None Observed
Spalling	None Observed
Any Visible Reinforcing	None Observed
Any Seepage or Efflorescence	Possible seepage to discharge channel.
Drain Holes	None Observed
Discharge Channel	Joins primary spillway channel below dam.
General Condition	Good
Loose Rock Overhanging Channel	None Observed
Trees Overhanging Channel	Yes
Floor of Channel	Rip-rap and rock
Other Obstructions	A 46 inch wide by 60 inch high concrete box culvert under Route 313, approximately 100 feet below the dam.

APPENDIX B

ENGINEERING DATA

APPENDIX B-1

DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS AND LOCATION

Mr. Victor J. Galgowski
Dam Safety Engineer
Water and Related Resources Unit
Department of Environmental Protection
State of Connecticut
State Office Building
Hartford, Connecticut 06115

Ansonia-Derby Water Company
230 Beaver Street
Ansonia, Connecticut 06401

APPENDIX B-2

COPIES OF PAST INSPECTION REPORTS

No. 517

3

ST 590

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

Inventoried By WWS

Date 12 MAY 1964

Name of Dam or Pond MIDDLE RESERVOIR

Code No. H 11.8 N 16 BV 2.4

Nearest Street Location MAPLE STREET

Town SEYMOUR

U.S.G.S. Quad. ANSONIA

Name of Stream BEAVER BROOK

Owner THE ANSONIA WATER COMPANY

Address 354 MAIN STREET

ANSONIA

LAT. 41° 21.9'

LONG. 73° 03.7'

WK
7/77

Pond Used For WATER SUPPLY DA 0.575M

Dimensions of Pond: Width 200 FEET Length 600 FEET Area 3 ACRES

400?

Total Length of Dam 300 FEET Length of Spillway 20 FEET

Location of Spillway CENTER OF DAM

Height of Pond Above Stream Bed 30 FEET

Height of Embankment Above Spillway 2 FEET

Type of Spillway Construction CONCRETE

Type of Dike Construction MASONRY

Downstream Conditions RIMMON ROAD

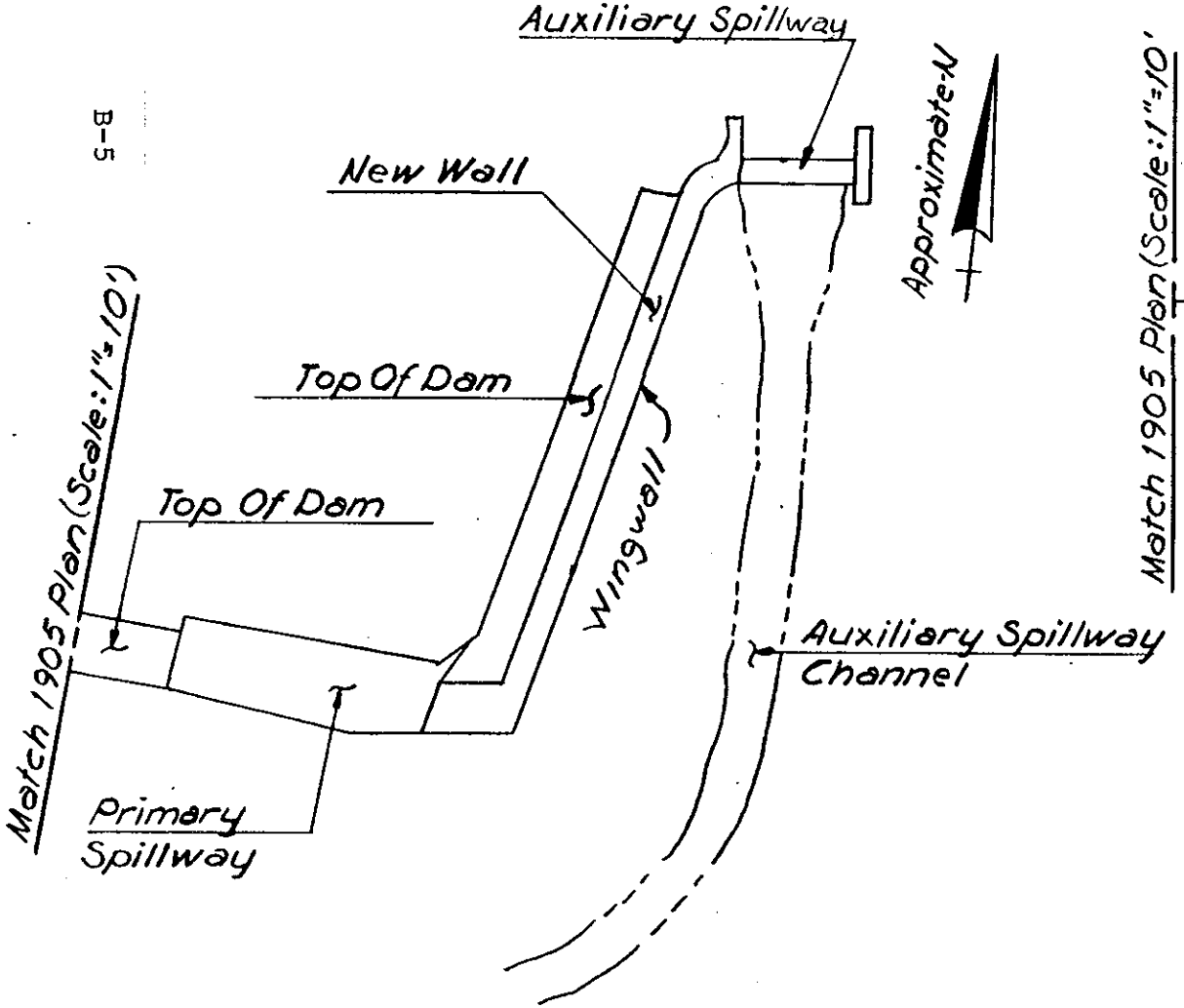
Summary of File Data

Remarks SLIGHT LEAKAGE AT BASE OF DAM

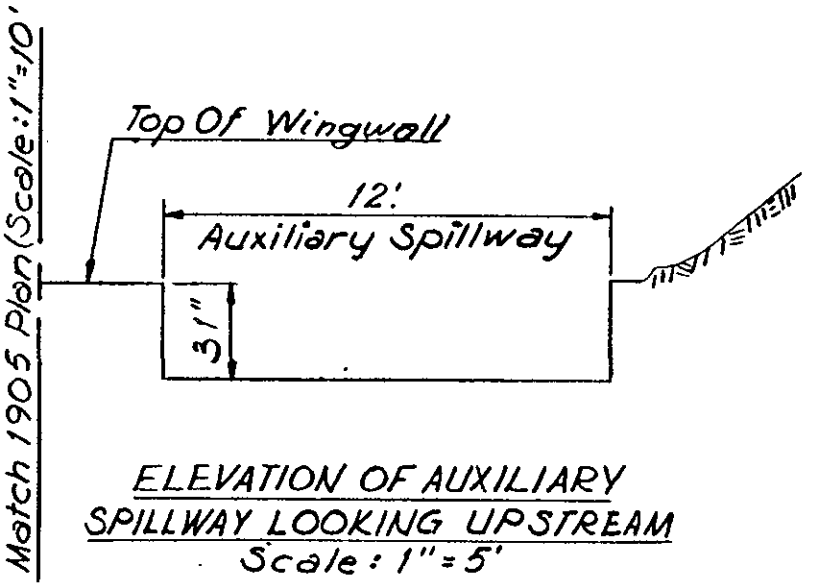
Would Failure Cause Damage? YES Class B

APPENDIX B-3

RECORD DRAWINGS AND SKETCHES



PLAN OF SPILLWAYS
Scale : 1"=20'

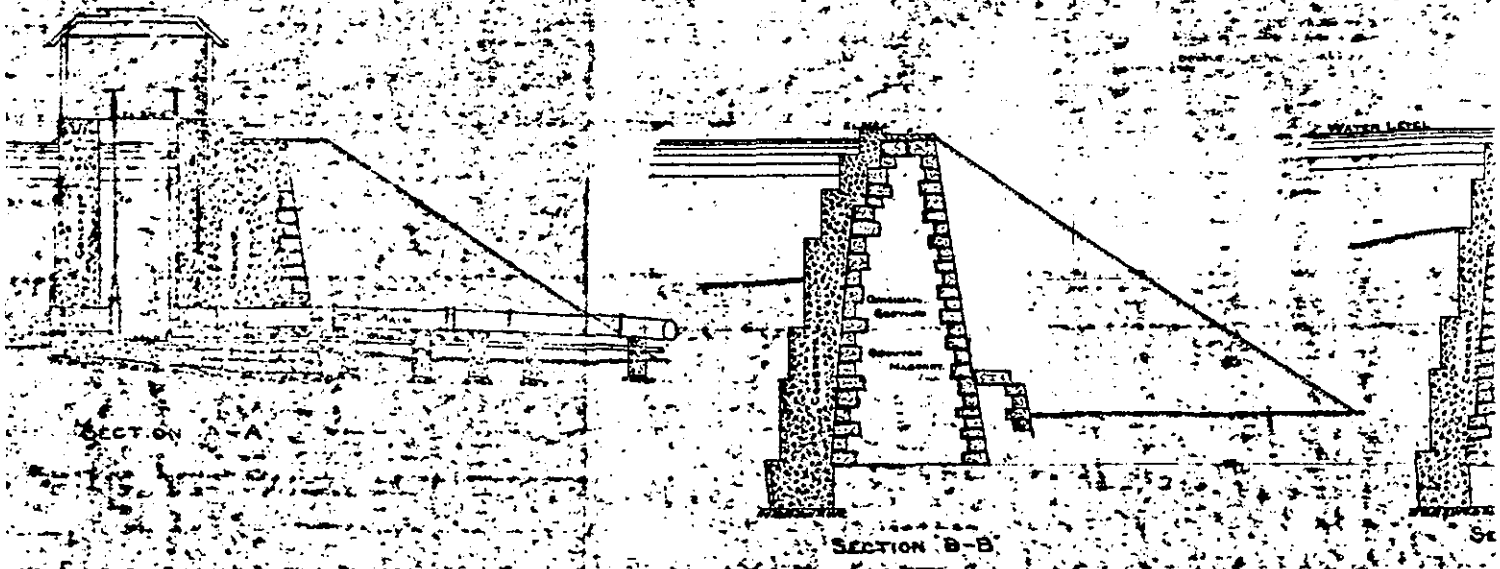


ELEVATION OF AUXILIARY SPILLWAY LOOKING UPSTREAM
Scale : 1"=5'

NOTE:
All Dimensions Shown Are Plus Or Minus.

MIDDLE RESERVOIR DAM

JAMES P. PURCELL ASSOCIATES, INC.
ENGINEERS • ARCHITECTS • PLANNERS



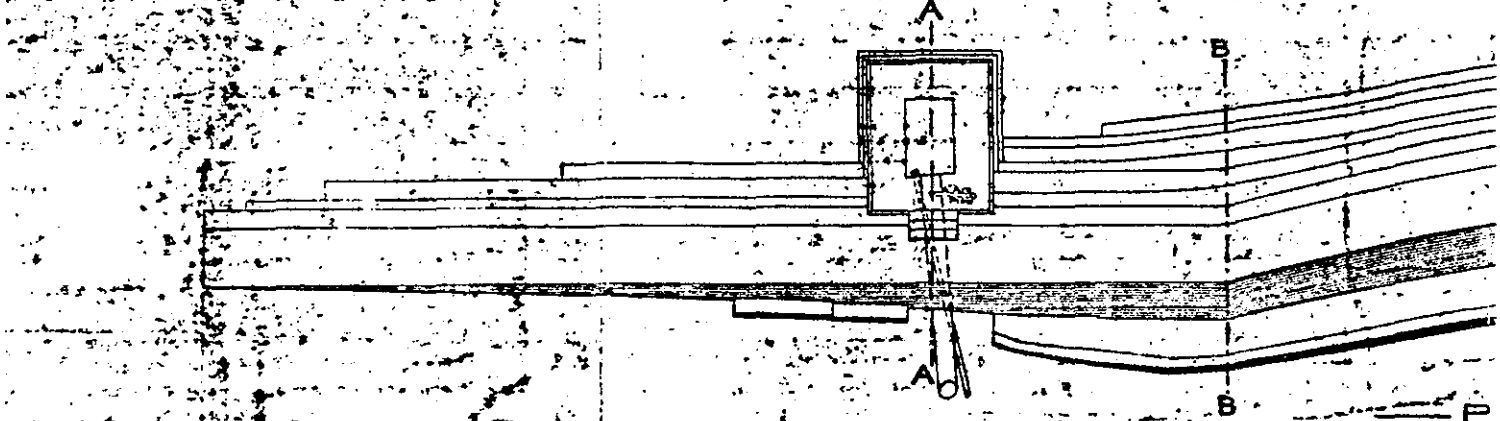
THE ANSONIA WATER CO.

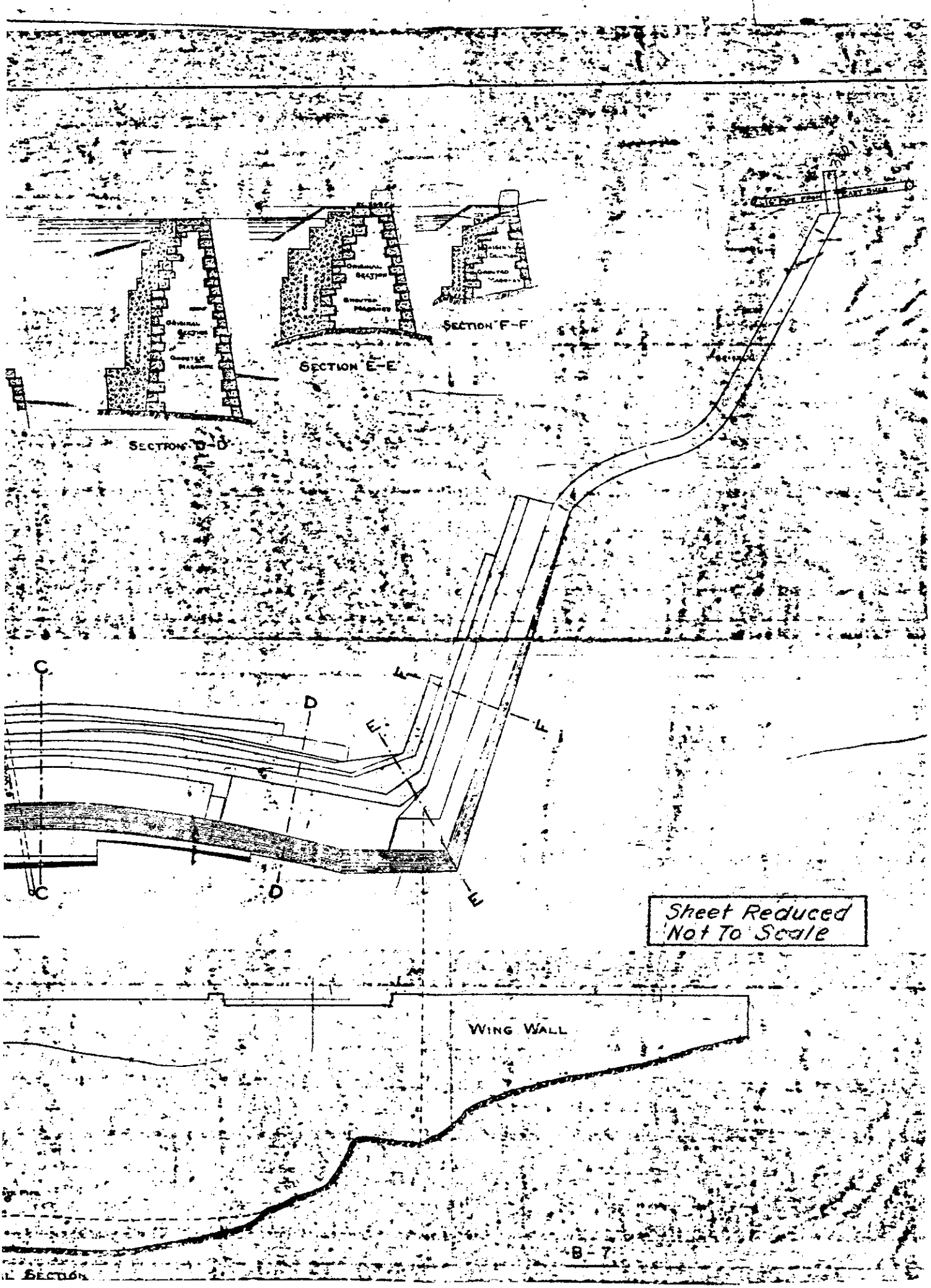
IMPROVEMENT OF DAM AT MIDDLE RESERVOIR

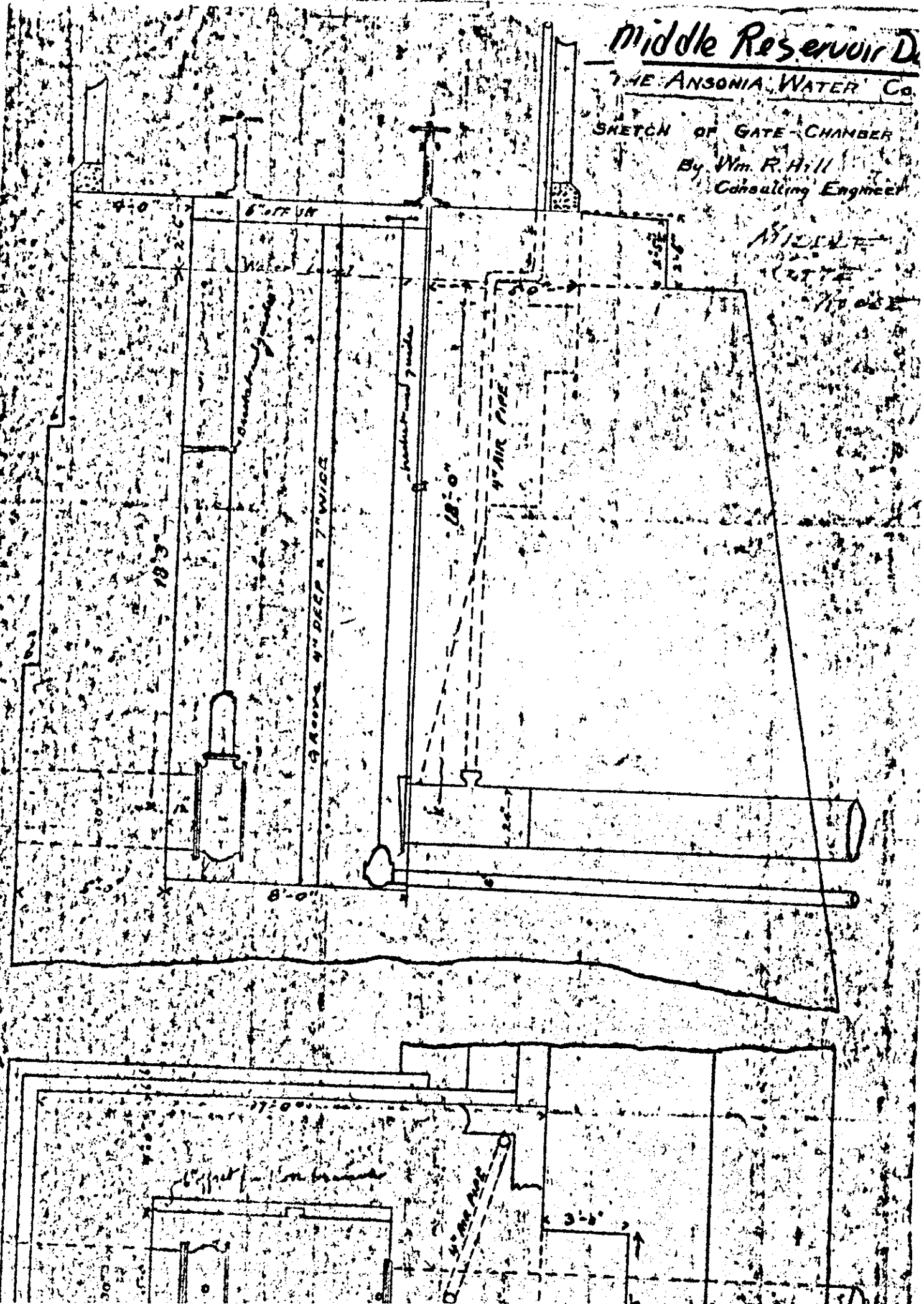
TOWN OF SEYMOUR, CONN.

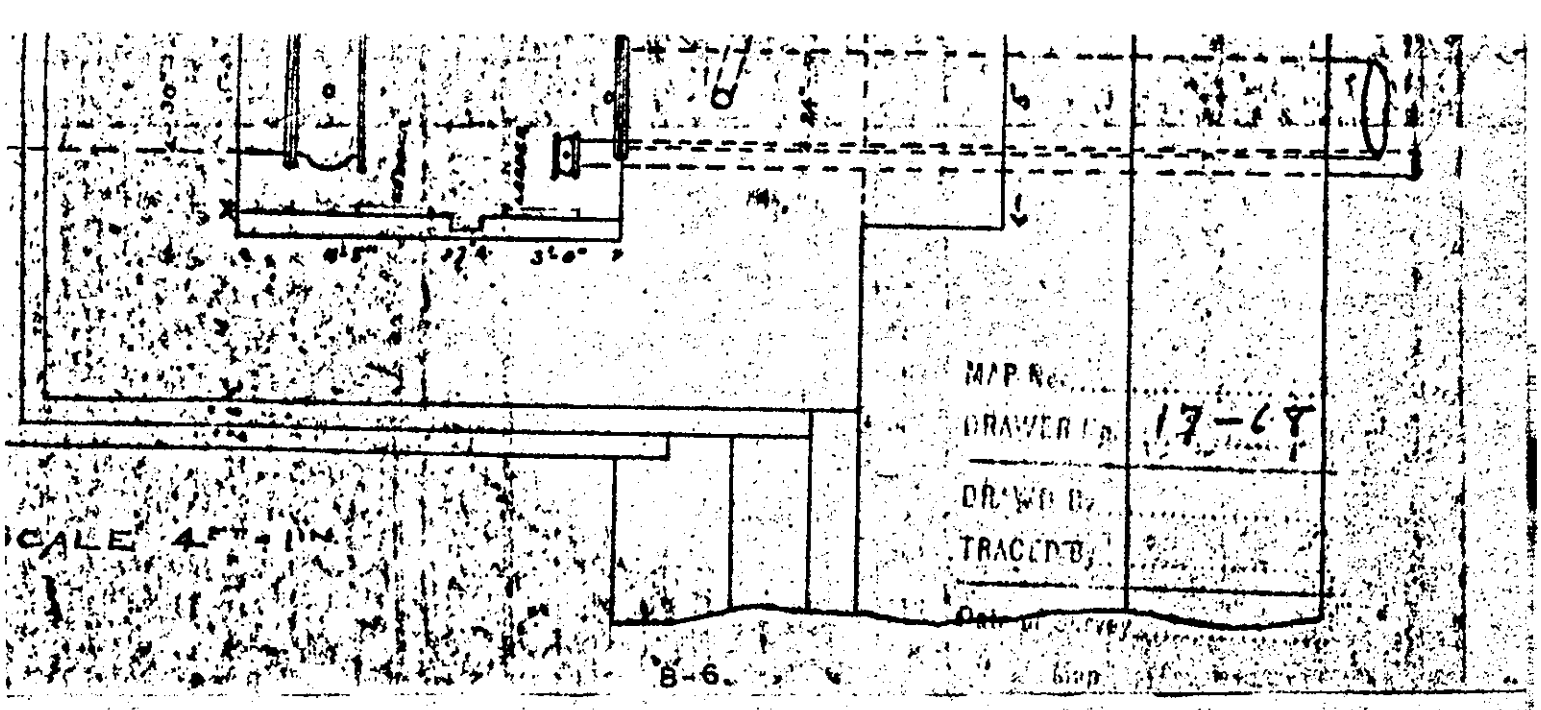
SCALE 1"=10' JUNE – OCT. 1905.

CHARLES H. NICHOLS



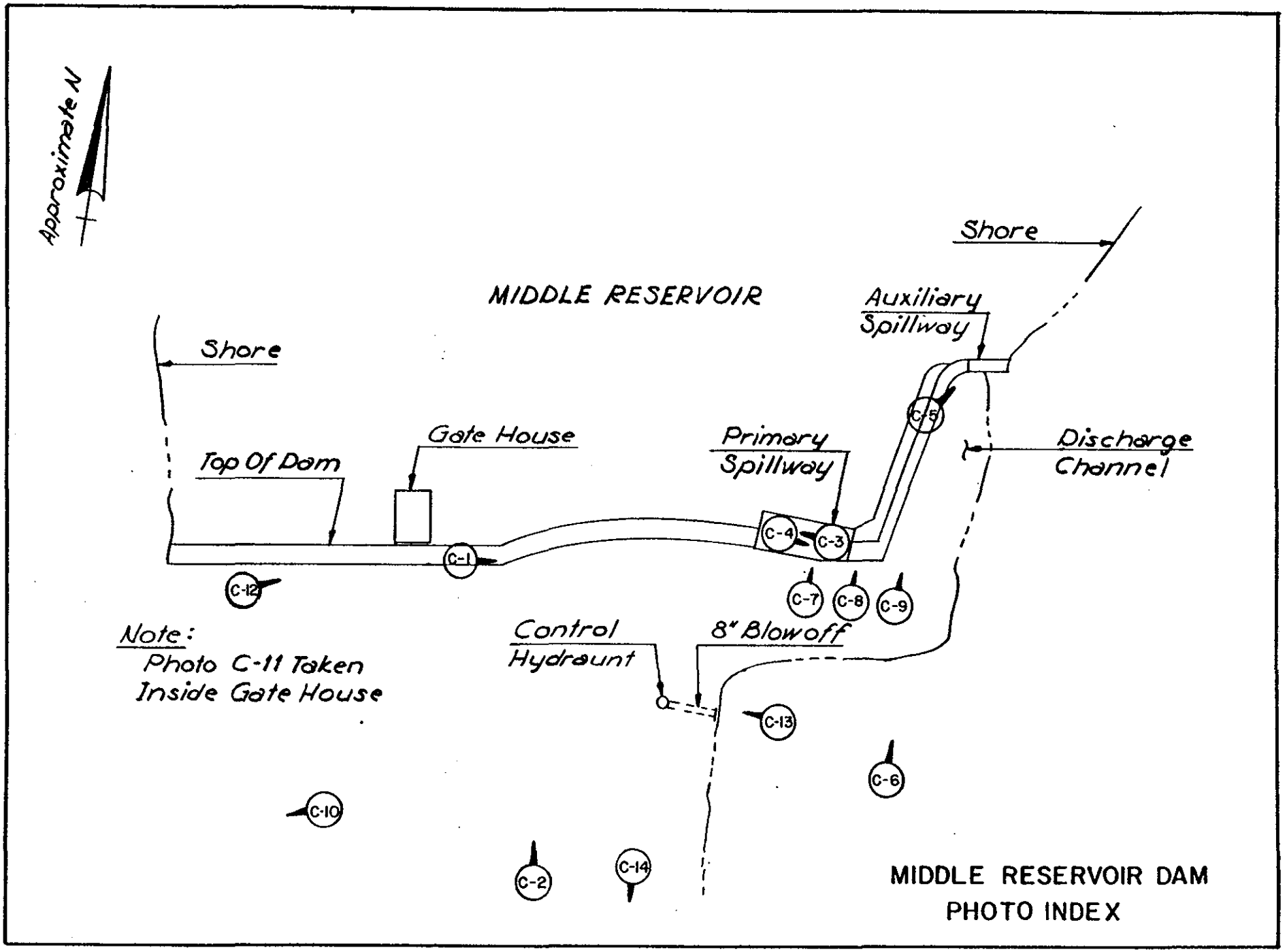

SECTION F-F
SECTION E-E
SECTION D-D
C
D
E
C
D
E
Sheet Reduced
Not To Scale
WING WALL
B-7


Middle Reservoir D
The Ansonia Water Co.
Sketch of Gate-Chamber
By Wm. R. Hill
Consulting Engineer
6" OFF VA
Water
4" AIR PIPE
8'-0"
3'-6"

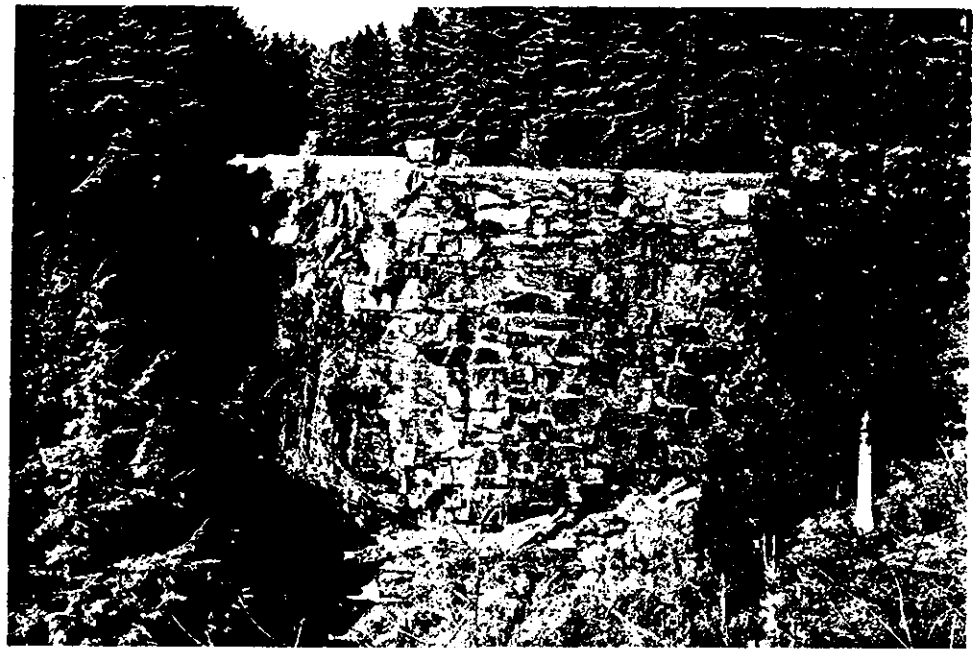

MAP No.
DRAWER No. 17-67
DRAWN By
TRACED By
SCALE 4" = 1'-0"
B-6

APPENDIX C

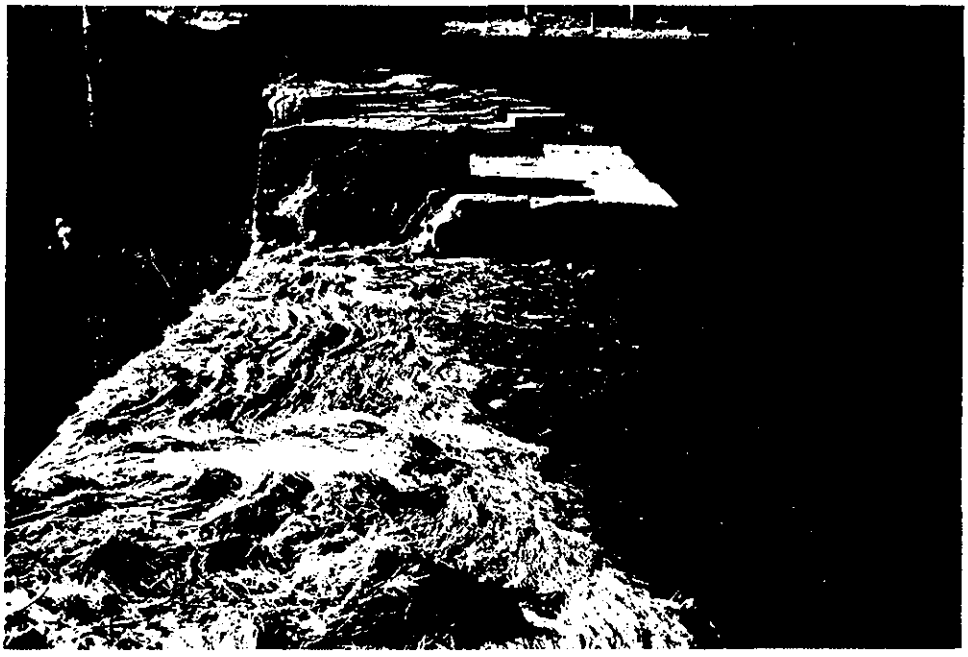
PHOTOGRAPHS


Approximate N
MIDDLE RESERVOIR
Shore
Shore
Auxiliary Spillway
Gate House
Top Of Dam
Primary Spillway
Discharge Channel
C-1
C-2
C-3
C-4
C-5
C-6
C-7
C-8
C-9
C-10
C-12
C-13
C-14
Note:
Photo C-11 Taken Inside Gate House
Control Hydraunt
8" Blowoff
MIDDLE RESERVOIR DAM
PHOTO INDEX

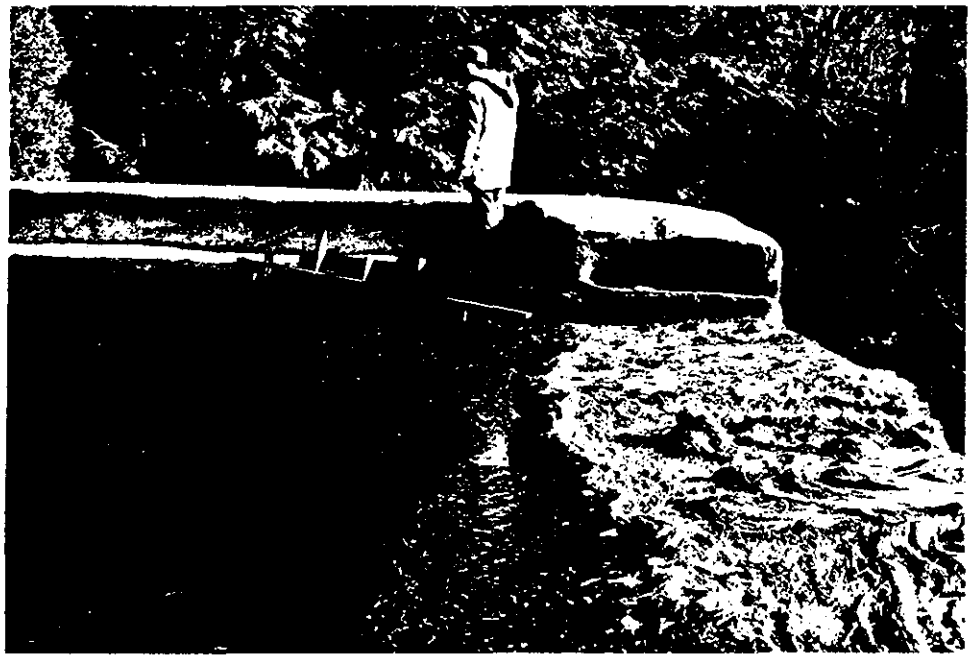
C-1 SPILLWAY AND DOWNSTREAM FACE OF DAM - LOOKING EAST



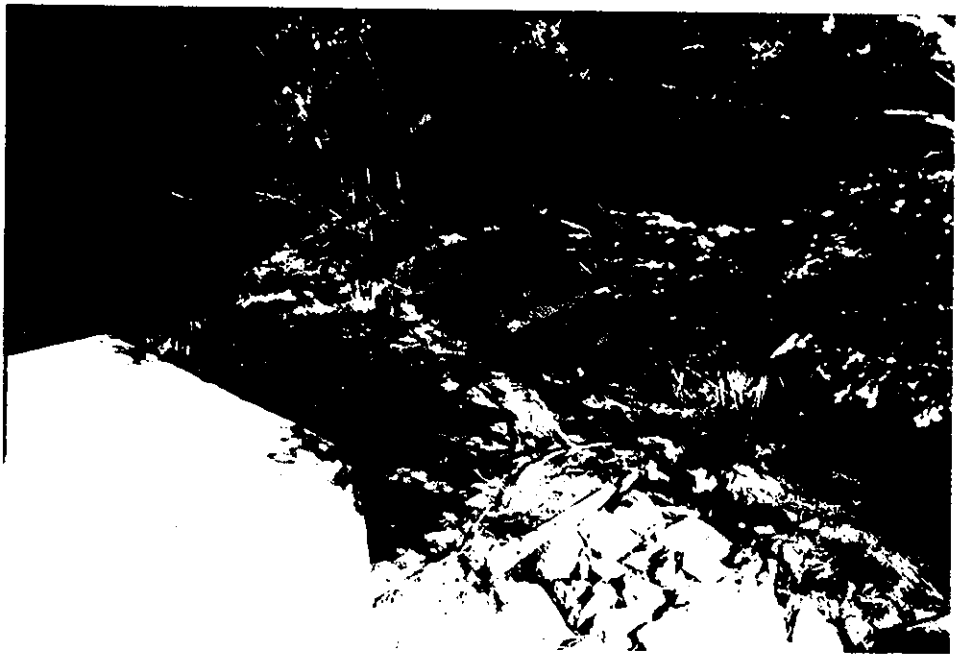
C-2 SPILLWAY AND DOWNSTREAM FACE OF DAM - LOOKING NORTH



C-3 TOP OF DAM AND SPILLWAY - LOOKING WEST



C-4 TOP OF DAM AND SPILLWAY - LOOKING EAST



C-5 AUXILIARY SPILLWAY AT EASTERN ABUTMENT

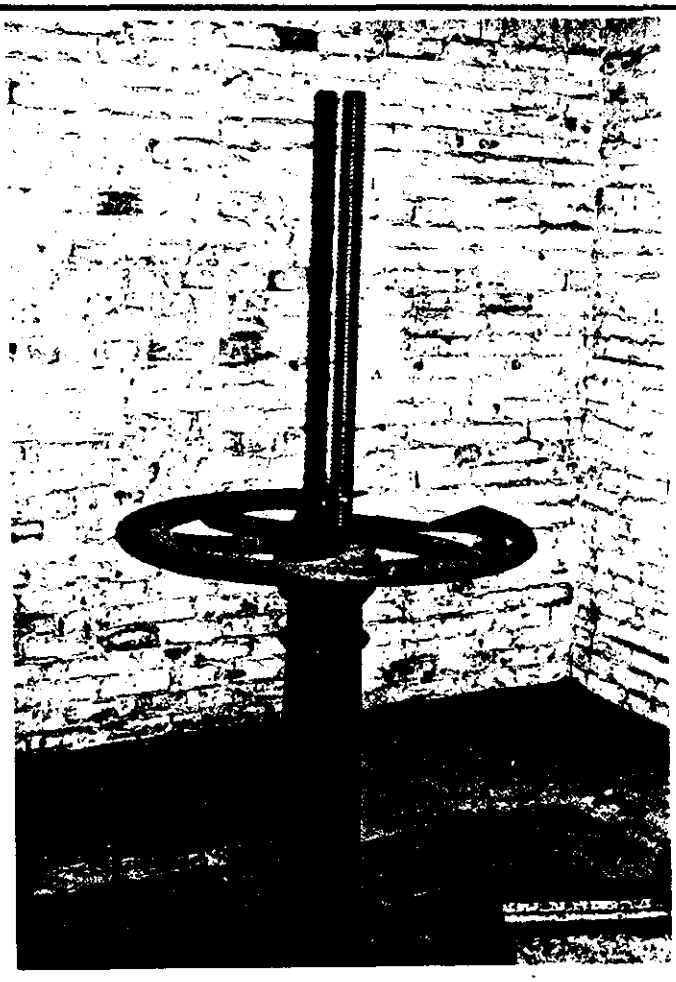
C-6 AUXILIARY SPILLWAY DISCHARGE CHANNEL

C-7 SEEPAGE THROUGH DOWNSTREAM FACE OF DAM

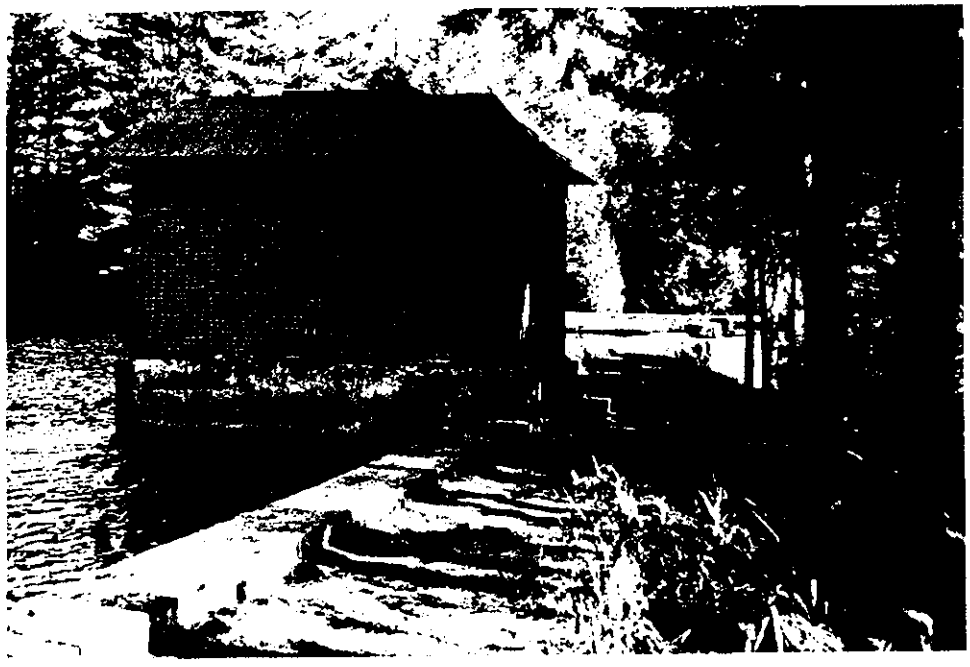
C-8 SEEPAGE FROM GROUND AT TOE OF DOWNSTREAM FACE OF DAM

C-9 VEGETATION ON EASTERN DOWNSTREAM FACE OF DAM

C-10 FLOW FROM GROUND DOWNSTREAM OF DAM



C-11 LIFT MECHANISM FOR 30 INCH GATE VALVE - INSIDE GATE HOUSE



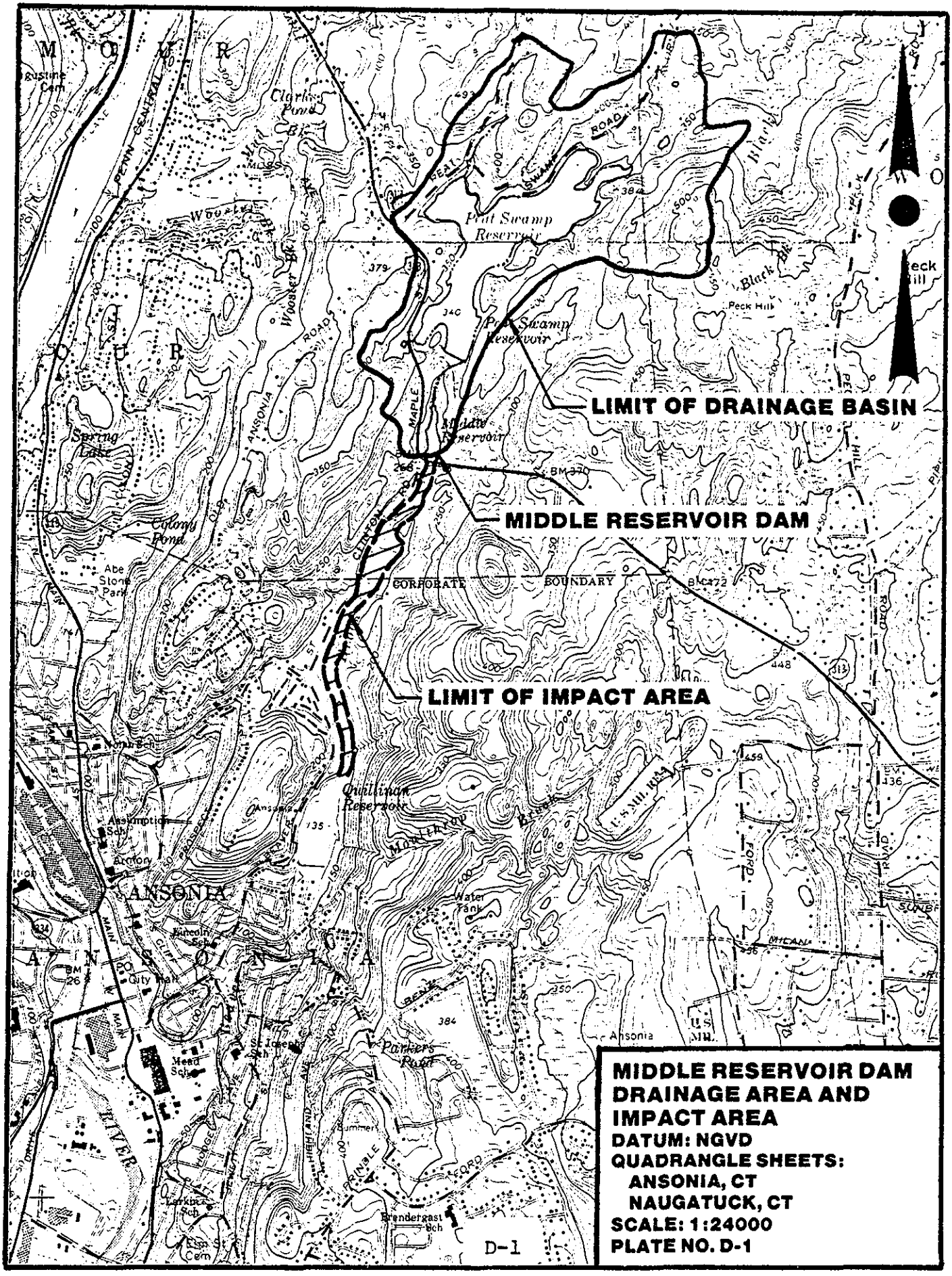
C-12 GATE HOUSE

C-13 CONTROL HYDRANT AND 8 INCH BLOWOFF

C-14 DOWNSTREAM CHANNEL AND BOX CULVERT BENEATH ROUTE 313

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



MIDDLE RESERVOIR DAM DRAINAGE AREA AND IMPACT AREA

DATUM: NGVD

QUADRANGLE SHEETS:
ANSONIA, CT
NAUGATUCK, CT

SCALE: 1:24000

PLATE NO. D-1

HYDROLOGIC AND HYDRAULIC ANALYSIS
SUMMARY SHEET

Dam Middle Reservoir Dam

Test Flood 1/2 PMF

INFLOW HYDROGRAPH DEVELOPMENT

Drainage Area 0.68 sq. mi.

Probable Maximum Precipation
24 hour - 200 square mile PMP 22 inches

Initial Railfall Loss 0 Inch
Uniform Railfall loss .1 Inch

Snyder's Lag 2.25 hours
Snyder's Peaking Coefficient .625

Test Flood Inflow 770 CFS

PMF Inflow 1540 CFS

RESERVOIR ROUTING AND DAM OVERTOPPING

Test Flood Outflow 765 CFS

Spillway Capacity at Top of Dam 132 CFS
(Primary and Auxiliary) 17 % of Test Flood

Flow Over Spillway at Test Flood 340 CFS

Spillway Crest Elevation 267.4 Feet (Primary Spillway)
Top of Dam Elevation 268.4 Feet
Test Flood Elevation 269.4 Feet

LAST MODIFICATION 26 FEB 79

```
**********************************
    1               A1      DAM SAFETY ANALYSIS-JOB NO. 79-905/09 ERJ
    2               A2      MIDDLE RESERVOIR DAM-SEYMOUR-CONN.
    3               A3      1-22-80
    4               B    75       1       0       0       0       0       0       2       0       0
    5               B1    5
    6               J     1       2       1
    7               J1   .5      1.      0.      0.      0.      0.      0.      0.     0.0
    8               K     0       1       0       0       0       0       1       0
    9               K1      COMPUTATION OF PMF-DEVELOPMENT OF INFLOW HYDROGRAPH
   10               M     1       1     .68       0     .68       0       0       0       1
   11               P     0      22     110     124     133     142
   12               T     0       0       0       0       0       0       0      .1
   13               W  2.25    .625
   14               X   1.9     .05     2.0
   15               K     1       1       0       0       0       0       1
   16               K1      ROUTING INFLOW HYDROGRAPH THRU LAKE-OVERTOPPING ANALYSIS
   17               Y     0       0       0       1       1
   18               Y1    1       0       0       0       0       0      -1
   19               $A  3.0     3.5     4.0     5.0
   20               $E 267.6   268.4   270.0   272.0
   21               $$ 267.4      41     2.7     1.5
   22               $D 268.4     2.7     1.5   169.0
   23               K    99
```

DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 01/24/80.
TIME= 07.47.32.

DAM SAFETY ANALYSIS-JOB NO. 79-905/09 ERJ
MIDDLE RESERVOIR DAM-SEYMOUR-CONN.
1-22-80

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
75	1	0	0	0	0	0	2	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 2 LRTIO= 1
RTIOS= .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

COMPUTATION OF PMF-DEVELOPMENT OF INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.68	0.00	.68	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	110.00	124.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 2.25 CP= .63 NTA= 0

RECESSION DATA
STRTQ= 1.90 QRCSN= .05 RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 2.70 AND R= 1.94 INTERVALS

UNIT HYDROGRAPH 12 END-OF-PERIOD ORDINATES, LAG= 2.26 HOURS, CP= .63 VOL= 1.00

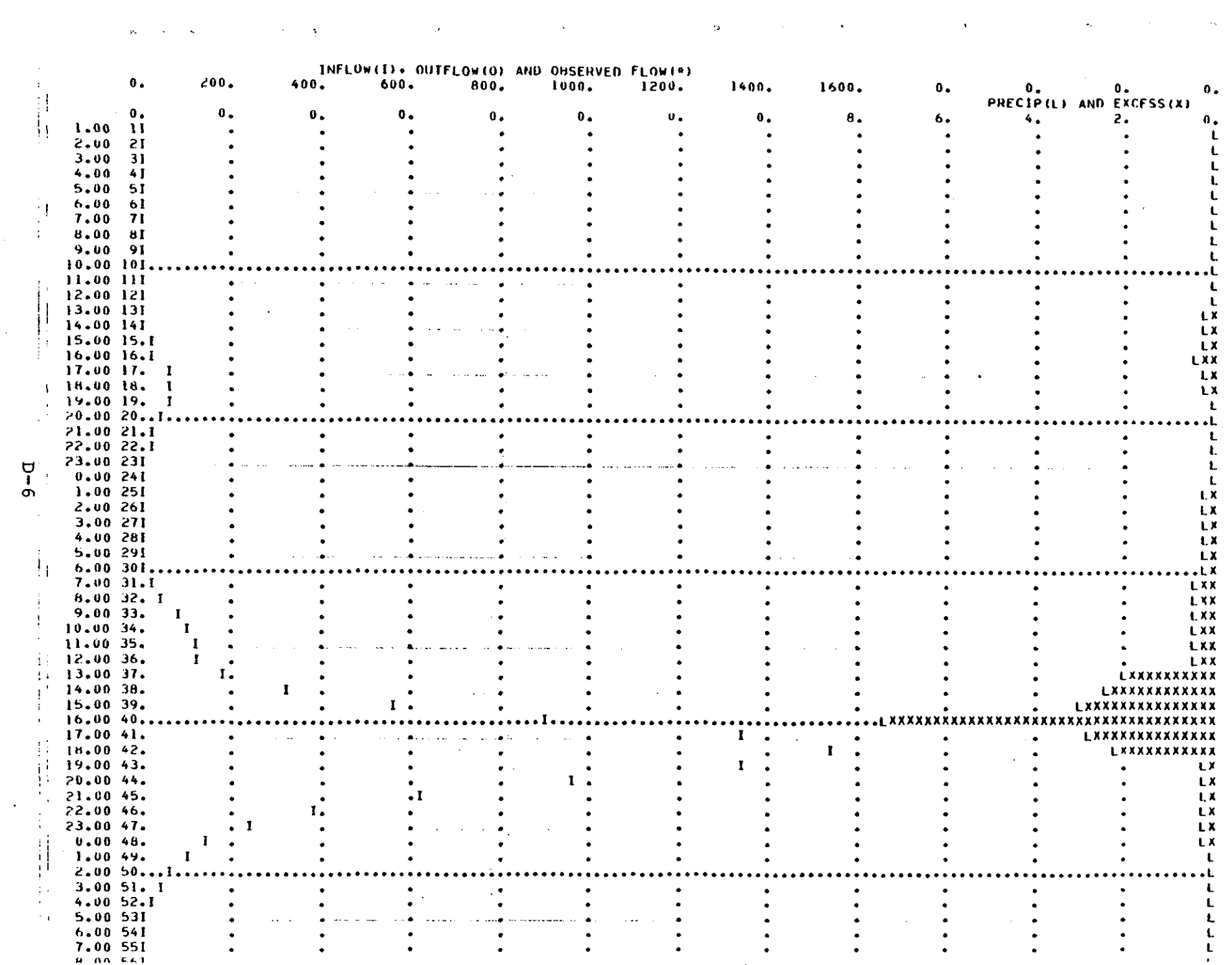
29.	90.	114.	84.	50.	29.	17.	10.	6.	4.
2.	1.								

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

1.01	6.00	6	.01	0.00	.01	1.	1.02	19.00	43	.16	.06	.10	1338.
1.01	7.00	7	.03	0.00	.03	1.	1.02	20.00	44	.16	.06	.10	964.
1.01	8.00	8	.03	0.00	.03	1.	1.02	21.00	45	.16	.06	.10	613.
1.01	9.00	9	.03	0.00	.03	1.	1.02	22.00	46	.16	.06	.10	372.
1.01	10.00	10	.03	0.00	.03	1.	1.02	23.00	47	.16	.06	.10	230.
1.01	11.00	11	.03	0.00	.03	1.	1.03	0.00	48	.16	.06	.10	146.
1.01	12.00	12	.03	0.00	.03	1.	1.03	1.00	49	0.00	0.00	0.00	94.
1.01	13.00	13	.13	.03	.10	2.	1.03	2.00	50	0.00	0.00	0.00	58.
1.01	14.00	14	.16	.06	.10	5.	1.03	3.00	51	0.00	0.00	0.00	33.
1.01	15.00	15	.20	.10	.10	12.	1.03	4.00	52	0.00	0.00	0.00	14.
1.01	16.00	16	.50	.40	.10	30.	1.03	5.00	53	0.00	0.00	0.00	7.
1.01	17.00	17	.18	.08	.10	56.	1.03	6.00	54	0.00	0.00	0.00	2.
1.01	18.00	18	.14	.04	.10	67.	1.03	7.00	55	0.00	0.00	0.00	1.
1.01	19.00	19	.01	0.00	.01	55.	1.03	8.00	56	0.00	0.00	0.00	1.
1.01	20.00	20	.01	0.00	.01	37.	1.03	9.00	57	0.00	0.00	0.00	0.
1.01	21.00	21	.01	0.00	.01	22.	1.03	10.00	58	0.00	0.00	0.00	0.
1.01	22.00	22	.01	0.00	.01	13.	1.03	11.00	59	0.00	0.00	0.00	0.
1.01	23.00	23	.01	0.00	.01	8.	1.03	12.00	60	0.00	0.00	0.00	0.
1.02	0.00	24	.01	0.00	.01	5.	1.03	13.00	61	0.00	0.00	0.00	0.
1.02	1.00	25	.11	.01	.10	3.	1.03	14.00	62	0.00	0.00	0.00	0.
1.02	2.00	26	.11	.01	.10	3.	1.03	15.00	63	0.00	0.00	0.00	0.
1.02	3.00	27	.11	.01	.10	2.	1.03	16.00	64	0.00	0.00	0.00	0.
1.02	4.00	28	.11	.01	.10	2.	1.03	17.00	65	0.00	0.00	0.00	0.
1.02	5.00	29	.11	.01	.10	2.	1.03	18.00	66	0.00	0.00	0.00	0.
1.02	6.00	30	.11	.01	.10	2.	1.03	19.00	67	0.00	0.00	0.00	0.
1.02	7.00	31	.41	.31	.10	11.	1.03	20.00	68	0.00	0.00	0.00	0.
1.02	8.00	32	.41	.31	.10	39.	1.03	21.00	69	0.00	0.00	0.00	0.
1.02	9.00	33	.41	.31	.10	74.	1.03	22.00	70	0.00	0.00	0.00	0.
1.02	10.00	34	.41	.31	.10	99.	1.03	23.00	71	0.00	0.00	0.00	0.
1.02	11.00	35	.41	.31	.10	115.	1.04	0.00	72	0.00	0.00	0.00	0.
1.02	12.00	36	.41	.31	.10	123.	1.04	1.00	73	0.00	0.00	0.00	0.
1.02	13.00	37	1.94	1.84	.10	172.	1.04	2.00	74	0.00	0.00	0.00	0.
							1.04	3.00	75	0.00	0.00	0.00	0.
									SUM	24.99	21.72	3.27	9509.
										(635.)	(552.)	(83.)	269.26)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1536.	1112.	382.	132.	9512.
CMS	43.	31.	11.	4.	269.
INCHES		15.21	20.90	21.69	21.69
MM		386.37	530.94	550.86	550.86
AC-FT		551.	758.	786.	786.
THOUS CU M		680.	935.	970.	970.


INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 200. 400. 600. 800. 1000. 1200. 1400. 1600.
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0. 0. 0. 0. 0. 0. 0. 0. 8.
1.00 11
2.00 21
3.00 31
4.00 41
5.00 51
6.00 61
7.00 71
8.00 81
9.00 91
10.00 101
11.00 111
12.00 121
13.00 131
14.00 141
15.00 15.I
16.00 16.I
17.00 17. I
18.00 18. I
19.00 19. I
20.00 20..I
21.00 21.I
22.00 22.I
23.00 231
0.00 241
1.00 251
2.00 261
3.00 271
4.00 281
5.00 291
6.00 301
7.00 31.I
8.00 32. I
9.00 33. I
10.00 34. I
11.00 35. I
12.00 36. I
13.00 37. I
14.00 38. I
15.00 39. I
16.00 40. I
17.00 41. I
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19.00 43. I
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21.00 45. I
22.00 46. I
23.00 47. I
0.00 48. I
1.00 49. I
2.00 50..I
3.00 51. I
4.00 52.I
5.00 531
6.00 541
7.00 551
PRECIP(L) AND EXCESS(X)
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HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

1.	1.	1.	1.	1.	1.	1.	1.	1.	0.
0.	0.	1.	3.	6.	15.	28.	33.	27.	18.
11.	7.	4.	2.	2.	1.	1.	1.	1.	1.
6.	19.	37.	50.	57.	62.	86.	162.	276.	452.
674.	768.	669.	482.	306.	186.	115.	73.	47.	29.
17.	7.	3.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.					

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	768.	556.	191.	66.	4756.
CMS	22.	16.	5.	2.	135.
INCHES		7.61	10.45	10.84	10.84
MM		193.19	265.47	275.43	275.43
AC-FT		276.	379.	393.	393.
THOUS CU M		340.	467.	485.	485.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	5.	12.	30.	56.	67.	55.	37.
22.	13.	8.	5.	3.	3.	2.	2.	2.	2.
11.	39.	74.	99.	115.	123.	172.	324.	551.	904.
1347.	1536.	1338.	964.	613.	372.	230.	146.	94.	58.
33.	14.	7.	2.	1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.					

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1536.	1112.	382.	132.	9512.
CMS	43.	31.	11.	4.	269.
INCHES		15.21	20.90	21.69	21.69
MM		386.37	530.94	550.86	550.86
AC-FT		551.	758.	786.	786.
THOUS CU M		680.	935.	970.	970.

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HYDROGRAPH ROUTING

ROUTING INFLOW HYDROGRAPH THRU LAKE-OVERTOPPING ANALYSIS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

SURFACE AREA=	3.	4.	4.	5.
CAPACITY=	0.	3.	9.	18.
ELEVATION	267.	268.	270.	272.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
268.4	2.7	1.5	169.

STATION 1. PLAN 1. RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	0.	1.	1.	4.	10.	22.	32.	31.	22.
14.	9.	6.	4.	2.	2.	1.	1.	1.	1.
3.	12.	30.	46.	55.	61.	78.	144.	272.	435.
665.	766.	680.	492.	318.	193.	123.	84.	54.	35.
21.	11.	5.	3.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.					

STORAGE

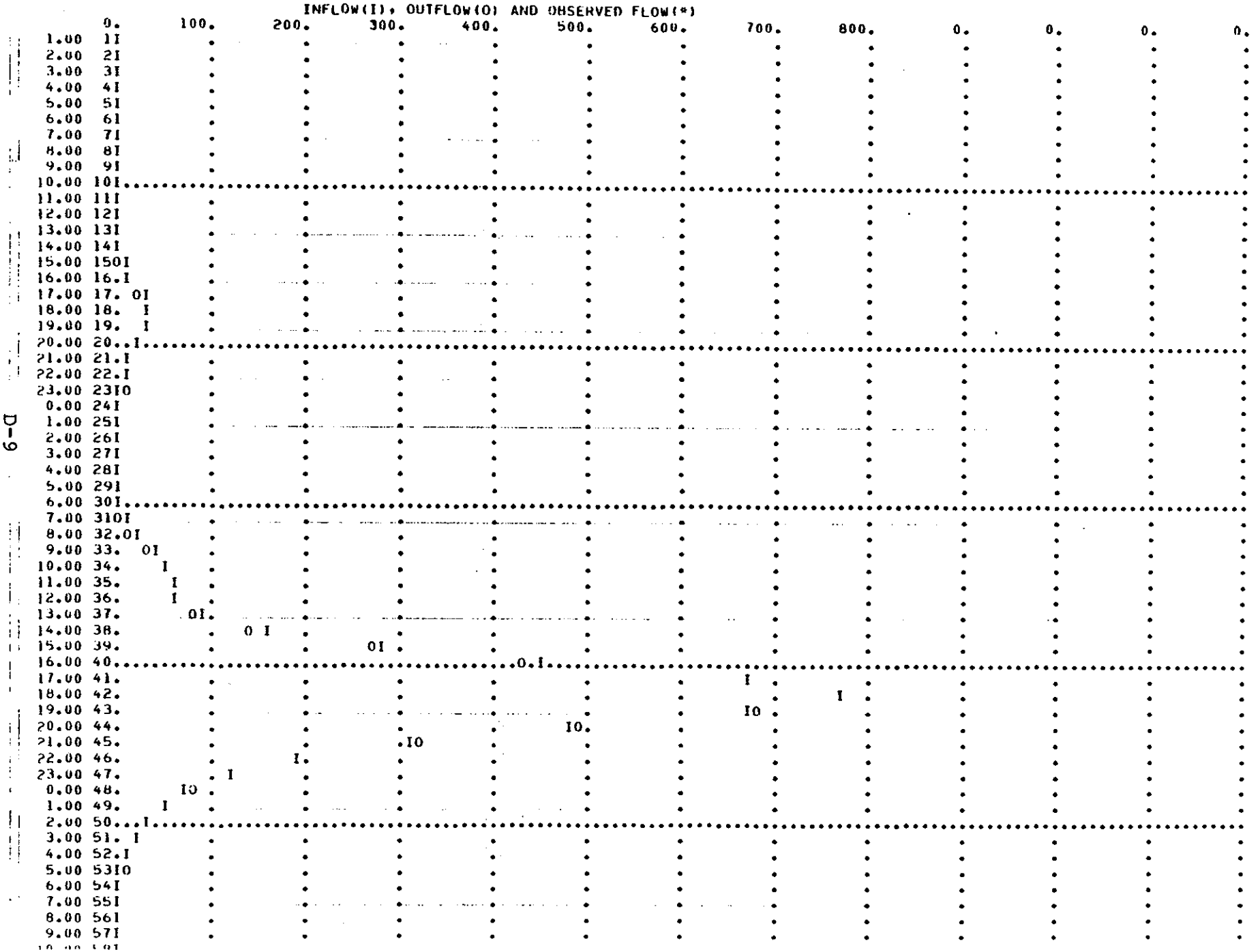
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	2.	2.	2.	3.	4.	5.	5.
6.	7.	7.	6.	5.	4.	3.	3.	2.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.					

STAGE

267.4	267.4	267.4	267.4	267.4	267.4	267.4	267.4	267.4	267.4
267.4	267.4	267.4	267.5	267.5	267.6	267.7	267.8	267.8	267.7
267.7	267.6	267.5	267.5	267.5	267.5	267.5	267.5	267.4	267.4
267.5	267.6	267.8	268.0	268.0	268.1	268.2	268.5	268.8	269.0
269.3	269.4	269.3	269.1	268.8	268.6	268.4	268.2	268.0	267.9
267.7	267.6	267.5	267.5	267.5	267.4	267.4	267.4	267.4	267.4
267.4	267.4	267.4	267.4	267.4	267.4	267.4	267.4	267.4	267.4
267.4	267.4	267.4	267.4	267.4					

PEAK OUTFLOW IS 766. AT TIME 42.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	766.	555.	191.	66.	4758.
CMS	22.	16.	5.	2.	135.
INCHES		7.60	10.45	10.85	10.85
MM		193.00	265.40	275.55	275.55
AC-FT		275.	379.	393.	393.
THOUS CU M		340.	467.	485.	485.


INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 100. 200. 300. 400. 500. 600. 700. 800. 0. 0. 0. 0.

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	3.	8.	22.	47.	65.	59.	42.
27.	17.	10.	7.	4.	3.	3.	2.	2.	2.
6.	26.	62.	93.	111.	123.	164.	309.	537.	883.
1329.	1536.	1353.	983.	629.	384.	239.	153.	102.	68.
40.	21.	10.	5.	2.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.					

STORAGE

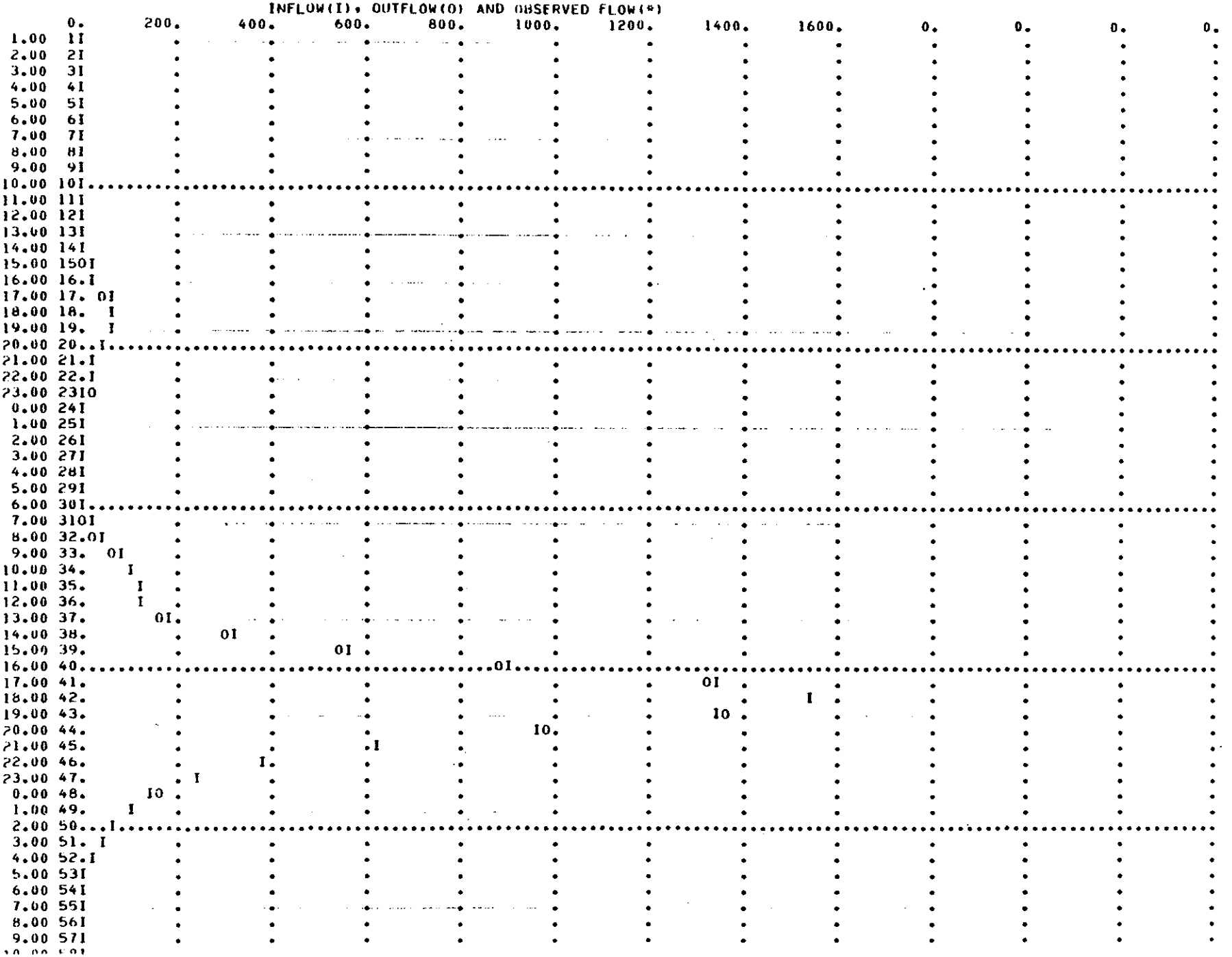
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	2.	2.	2.	2.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	1.	2.	3.	3.	3.	4.	5.	6.	7.
9.	10.	9.	8.	6.	5.	4.	4.	3.	2.
2.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.					

STAGE

267.4	267.5	267.5	267.5	267.5	267.5	267.5	267.4	267.4	267.4
267.4	267.4	267.5	267.6	267.7	268.0	268.1	268.1	267.9	
267.8	267.7	267.6	267.6	267.5	267.5	267.5	267.5	267.5	267.5
267.5	267.8	268.1	268.3	268.4	268.4	268.6	268.8	269.1	269.5
269.9	270.1	270.0	269.6	269.2	268.9	268.7	268.5	268.3	268.1
267.9	267.7	267.6	267.5	267.5	267.5	267.4	267.4	267.4	267.4
267.4	267.4	267.4	267.4	267.4	267.4	267.4	267.4	267.4	267.4
267.4	267.4	267.4	267.4	267.4					

PEAK OUTFLOW IS 1536. AT TIME 42.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1536.	1111.	382.	132.	9514.
CMS	44.	31.	11.	4.	269.
INCHES		15.20	20.90	21.69	21.69
MM		386.08	530.84	550.98	550.99
AC-FT		551.	758.	786.	786.
THOUS CU M		680.	934.	970.	970.


INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 200. 400. 600. 800. 1000. 1200. 1400. 1600. 0. 0. 0. 0.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 1.00
HYDROGRAPH AT	1	.68	1	768.	1536.
	(	1.76)	(	21.74)(	43.48)(
ROUTED TO	1	.68	1	766.	1536.
	(	1.76)	(	21.68)(	43.51)(

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	267.40	267.40	268.40
STORAGE	0.	0.	3.
OUTFLOW	0.	0.	111.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	269.40	1.00	7.	766.	10.00	42.00	0.00
1.00	270.13	1.73	10.	1536.	14.00	42.00	0.00

A. Size Classification

Height of dam = 27 ft.; hence Small

Storage capacity at top of dam (elev. 268.4) = 36 AC-FT.; hence Small

Adopted size classification Small

B.i) Hazard Potential

The Dam is located upstream of the Quillinan Reservoir which may be affected by the failure of the Middle Reservoir Dam.

ii) Impact of Failure of Dam at Maximum Pool (Top of Dam)

It is estimated from the rule of "thumb" failure hydrograph, that the following adverse impacts are a possibility by the failure of this dam.

a) Loss of homes 0 ;
b) Loss of buildings 1 ;
c) Loss of highways or roads 2 ;
d) Loss of bridges 0 ;

The failure profile can affect a distance of 5000 feet from the dam.

C. Hazard Potential Classifications

HAZARD	SIZE	TEST FLOOD RANGE
Significant	Small	100 year to 1/2 PMF

Adopted Test Flood = 1/2 PMF = N/A CSM

= 770 CFS

D. Overtopping Potential

Drainage Area 435 = .68 sq. miles

Spillway crest elevation = (Primary Spillway) 267.4 NGVD

Top of Dam Elevation = 268.4 NGVD

Maximum spillway discharge

Capacity without overtopping of dam = 132 CFS
"test flood" inflow discharge = 770 CFS
"test flood" outflow discharge = 765 CFS

MIDDLE RESERVOIR DAM

Dam Failure Analysis

1. Failure discharge with pool at top of dam (elev. 268.4) = 8000 CFS
2. Depth of water in reservoir at time of failure = 27 ft.
3. Maximum depth of flow downstream of dam = 27 ft.
4. Water surface elevation just downstream of dam at time of failure) = 268 NGVD

The failure discharge of 8000 CFS will enter and flow downstream 5000 feet until the brook enters Quillinan Reservoir. Valley storage in this 5000 feet length of brook is substantial in reducing the discharge. Also due to roughness characteristics, obstructions and frictional losses, it is very likely that the unsteady dam failure flow will dissipate its wave and kinetic energy and thus convert to steady and uniform flow obeying Manning's formulae 5000 feet downstream. The failure profile will have the following hydraulic characteristics:

DISTANCE FROM THE DAM	WATER SURFACE ELEVATION NGVD	REMARKS
0	268.4	Upstream of Dam
0	268 ±	Downstream of Dam
200	235.0	Downstream of Dam
1000	195.9	
2000	183.0	
3000	166.0	
4000	153.4	
5000	142.9	Quillinan Res.

Beyond 5000 feet, The discharge enters Quillinan Reservoir failure discharge will flow in the below given channel characteristics:

Q = 1180 CFS; S = N/A

n = N/A ; b = N/A ; d = 3±

Side slopes = N/A

"Rule of Thumb Guidance for Estimating Downstream Dam Failure Analysis"

DATA

Name of Dam Middle Reservoir Dam

Location Town of Seymour, Connecticut

Drainage Area 0.68 sq. mi., Top of Dam 268.4 NGVD

Spillway Type overflow, broadcrested Crest of Spillway 267.4 NGVD

Surface Area @ Crest Elev. 3 Acres = .01 sq. mi.

Pool Bottom Near Dam = 241 NGVD

Assumed Side Slopes of Embankments = 1:1

Depth of Pool at Dam (Yo) = 27 Feet

Mid-Height Elev. 255 NGVD

Length of Dam at Crest = 135 Feet *

Length of Dam at Mid-Height = 135 Feet *

25 % of Dam Length at Mid-Height = W_b = 34 Feet

Step 1

Storage (S) at time of failure 36 Ac-FT
(Equal to top of dam)

Step 2

Peak Failure Discharge
$Q_{pl} = 8/27\ W_b\ \sqrt{9}\ Yo^{3/2}$

$= 1.68\ W_b\ Yo^{3/2} =$ 8000 cfs

Failure is assumed to coincide with pool elevation at top of dam.

* Length from wingwall to gatehouse.

The Quillinan Reservoir is located 5000 feet downstream of the Middle Reservoir dam. There is a 98 foot drop into the Quillinan Reservoir which will cause the dissipation of wave and kinetic energy of the failure discharge. Approximately, the water surface elevations between the Middle Reservoir dam and the Quillinan Reservoir will be as given on Dam Failure Analysis. The increase of depth in the Quillinan Reservoir due to failure of the Middle Reservoir dam is estimated to be 3 feet.

BY FGB DATE 11/27/79 SUBJECT DAM INSPECTION SHEET NO 1 OF 6
CHKD. BY ERJ DATE 1/15/80 STUDIES JOB NO 79-905

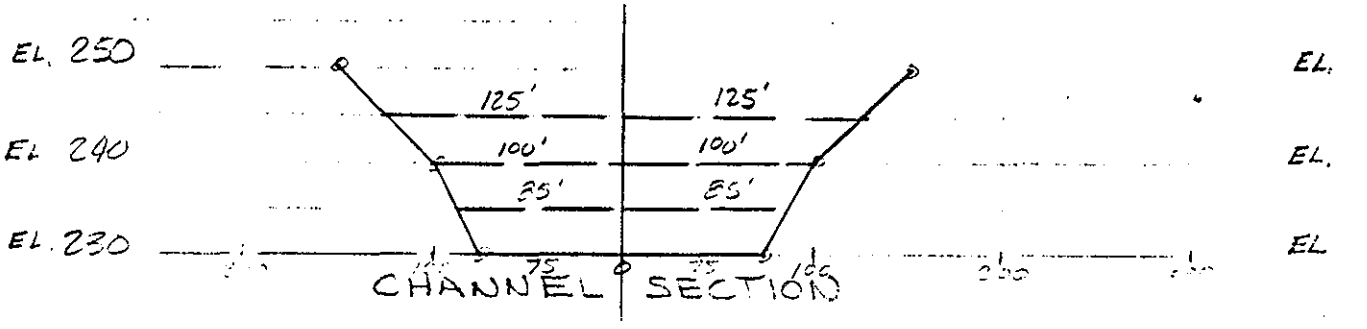
DOWNSTREAM W.S.EL. COMPUTATIONS

NAME OF DAM: Nitro Reservoir Dam

SECTION LOCATION: 200' DOWNSTREAM OF DAM

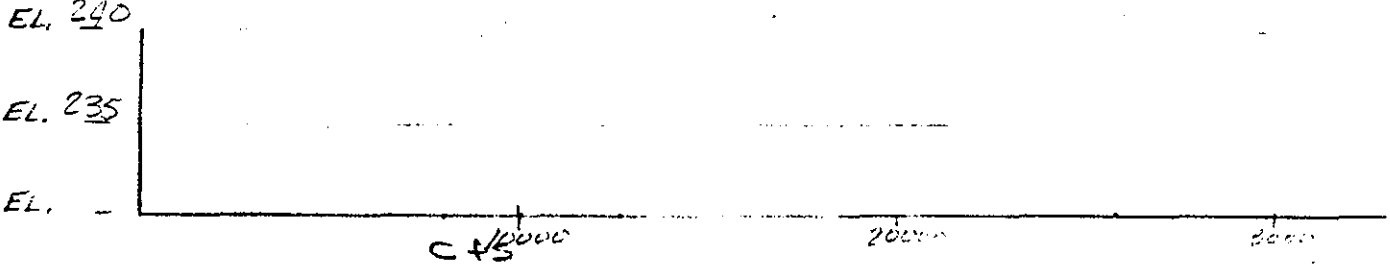
USING: $Q = 1.486/n \, A \, R^{2/3} \, S^{1/2}$

WHERE: n = 0.05 S = SLOPE = .0143 ft/ft.



Q_{P_1} = 7974 STORAGE (S) 33 Ac-ft.

ELEV	AREA	WP	R	$R^{2/3}$	$S^{1/2}$	1.486/n	Q	DEPTH
235	800	170	4.70	2.81	.12	29.72	8017	0'
240	1725	200	8.62	4.20	.12	29.72	25[illegible]	10'
245	2850	250	11.4	5.06	.12	29.72	51[illegible]	15'



STAGE DISCHARGE 7974 ELEV = 235 OR A D = 5

D-18 NEXT DOWNSTREAM SECTION [illegible] FT.

PURCELL ASSOCIATES

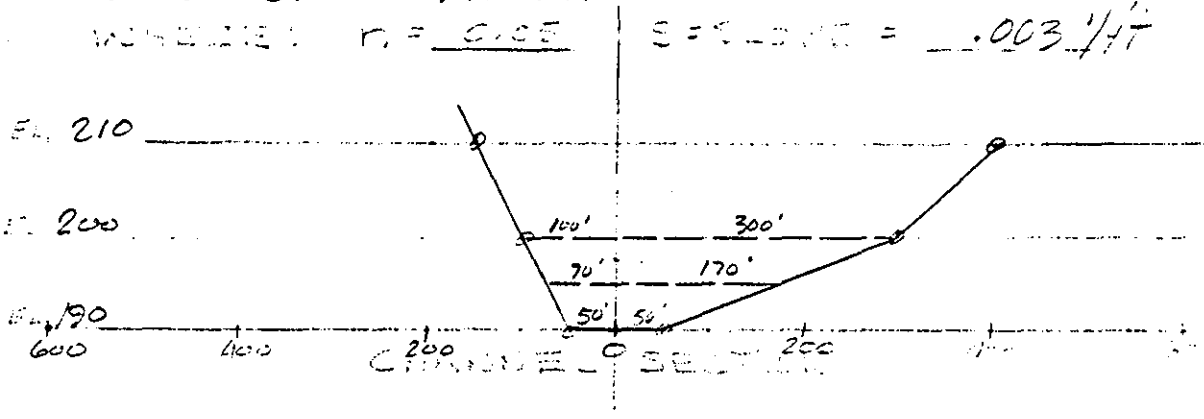
CHKD BY ERJ DATE 11/15/80

LINE OF DAM: Main Levee

SECTION LOCATION: 1000 CENTERLINE STA.

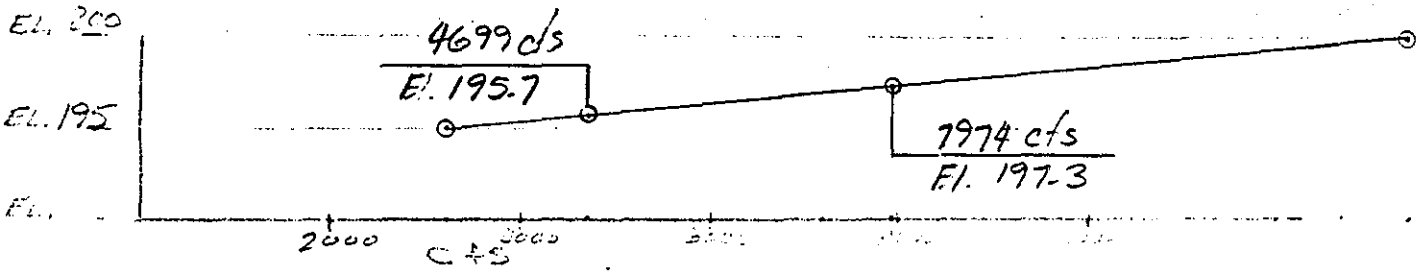
USING: $Q = 1.486/n \, A R^{2/3} S^{1/2}$

ROUGHNESS: n = 0.035 SLOPE = .003 ft/ft



Q_{PF} = 7974 cfs STORAGE (S) = 33 Ac-ft

ELEV	AREA	WP	R	$R^{2/3}$	$S^{1/2}$	$1.486/n$	Q	INTERVAL
195	850	240	3.54	2.32	.055	29.72	3223	5'
200	2450	400	6.12	3.35	.055	29.72	13416	5'
						29.72		



$V_1 = \frac{5+7.3}{2} \times (170+310 \times 800 \div 43,560) \frac{1}{2}$ = 13.6 Ac-ft

$Q_{P2} = Q_{PF} (1 - V/S)$ = 4699 cfs

$V_2 = \frac{5+5.7}{2} \times \left(\frac{170+250}{2} \times 800 \div 43560\right) \frac{1}{2}$ = 10.3 Ac-ft V_{AD} 11.9 Ac-ft

$Q_{PE} = Q_{PF} (1 - V_{AD}/S)$ = 5084 cfs

STAGE DISCHARGE: 5084 cfs ELEV 195.9 OR A D = 5.9

WIDTH OF CHANNEL/RIVER SECTION 1000 FT

CHKD BY: ERJ DATE: 1/15/20

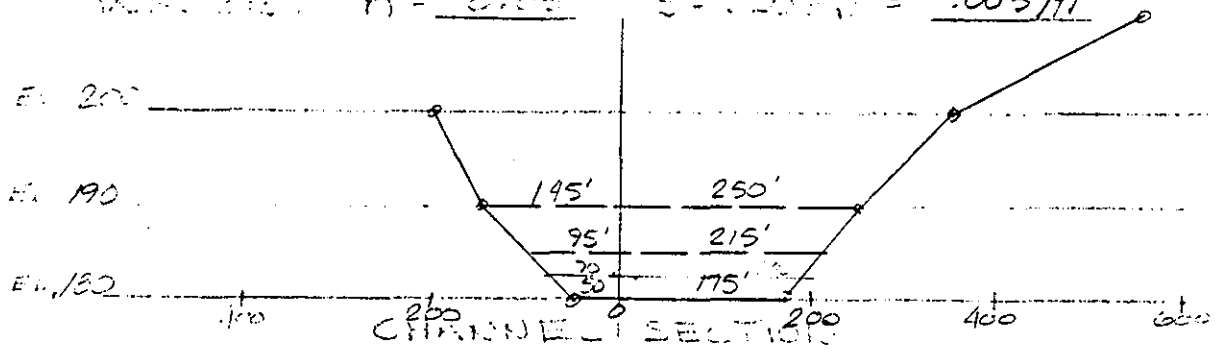
DETERMINATION OF EL. CONTROL SECTION

NAME OF DAM: Middle Reservoir Dam

SECTION LOCATION: 2000' DOWNSTREAM OF DAM

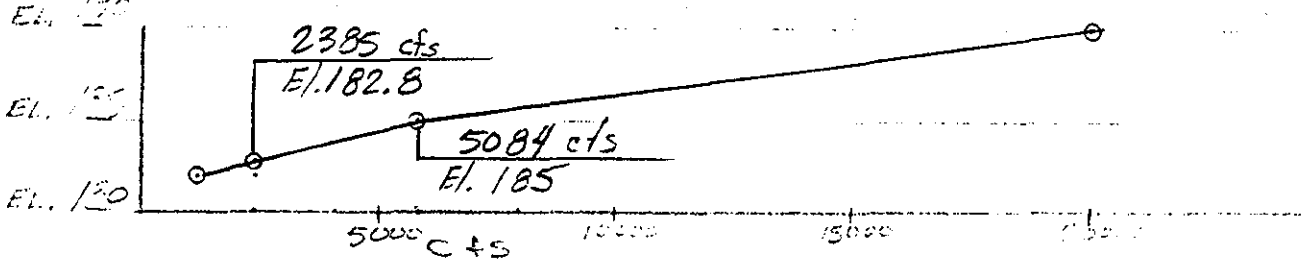
USING: $Q = 1.486/n \, A R^{2/3} S^{1/2}$

ASSUME: n = 0.05 SLOPE = .003'/ft



Q_{P1} = 5084 cfs STORAGE (S) 33 Ac-ft

ELEV	AREA	W.P.	R	$R^{2/3}$	$S^{1/2}$	1.486/n	Q	
185	1333	310	4.316	2.65	.055	29.72	5796	5
190	3100	395	7.848	3.95	.055	29.72	2003	0
182	485	260	1.865	1.51	.055	29.72	1197	



$V_1 = \frac{5.9+5}{2} \times (250+310 \times 1000 \div 43,560) \, 1/2 = 17.5$ Ac-ft

$Q_{P2} = Q_{P1} (1 - V/S) = 2385$ cfs

$V_2 = \frac{5.9+2.8}{2} \times (\frac{250+280}{2} \times 1000 \div 43560) \, 1/2 = 13.2$ Ac-ft V_{tot} 15.4 Ac-ft

$Q_{P2} = Q_{P1} (1 - V_{tot}/S)$ 2717 cfs

STAGE DISCHARGE: 2717 cfs ELEV: 183 CHECKED: ☐

NEXT DOWNSTREAM SECTION: 1000 ft

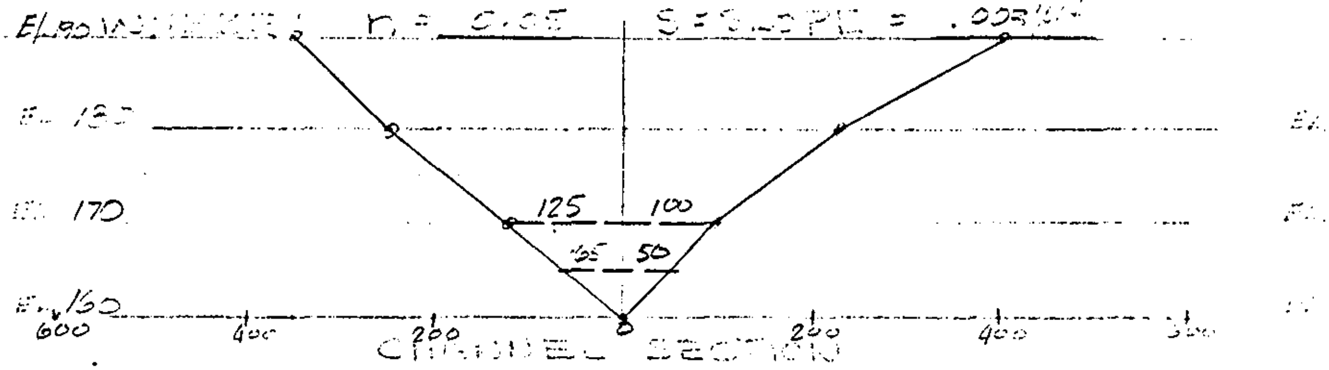
[illegible] DAM [illegible]

NAME OF DAM: [illegible]

SECTION LOCATION 3000' DOWNSTREAM OF [illegible]

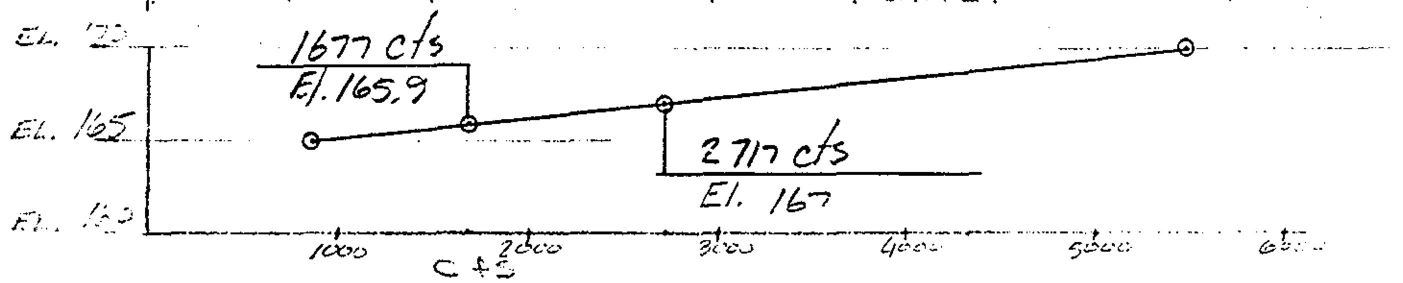
USING: $Q = 1.486/n \, A R^{2/3} S^{1/2}$

ELEVATION [illegible] n = 0.05 S = SLOPE = .0051



Q_{P1} = 2717 cfs STORAGE (S) 33 Ac-ft

ELEV	AREA	WP	R	$R^{2/3}$	$S^{1/2}$	1.486/n	Q	[illegible]
165	280	115	2.50	1.84	.055	29.72	866	5
170	1133	225	5.03	2.95	.055	29.72	5433	10
						29.72		



$V_1 = \frac{3+7}{2} \times (\frac{280+160}{2} \times 1000 \div 43,560) \, 1/2$ = 12.6 Ac-ft

$Q_{P2} = Q_{P1} (1 - V_1/S)$ = 1677 cfs

$V_2 = \frac{3+5.9}{2} \times (\frac{280+140}{2} \times 1000 \div 43560) \, 1/2$ = 10.7 Ac-ft V_{AVE} 11.6

$Q_{P3} = Q_{P1} (1 - V_{AVE}/S)$ 1762 cfs

STAGE [illegible] 1762 cfs ELEV 166 OR A [illegible] 6

NEXT DOWNSTREAM SECTION 1000 ft

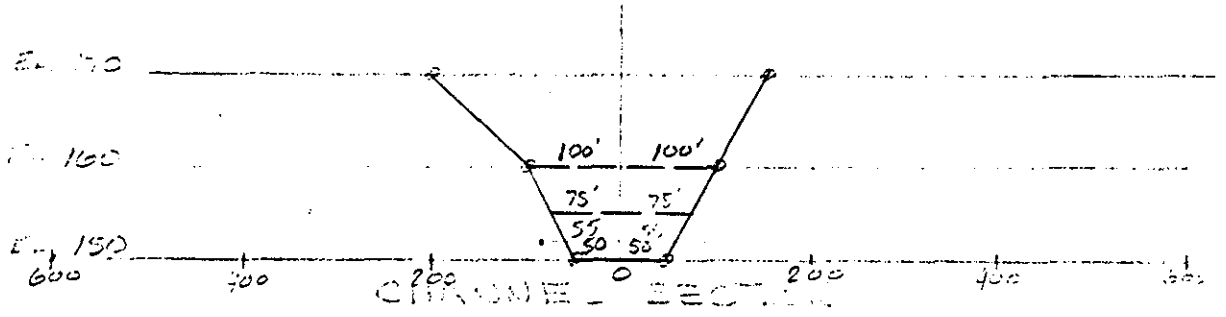
CHKD BY ERJ DATE 1/15/80

NAME OF DAM: Middle Pecos

SECTION LOCATION: 400' downstream

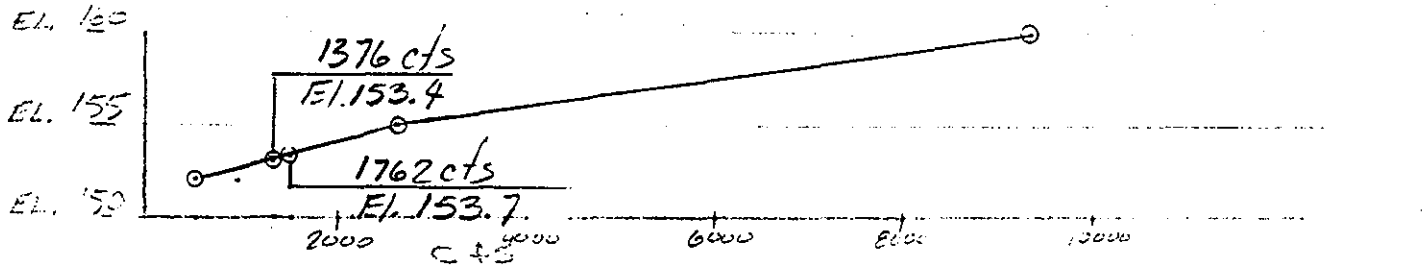
USING: $Q = 1.486/n A R^{2/3} S^{1/2}$

ASSUME: n = 0.05 SLOPE = .003 ft/ft



Q_P = 1762 cfs STORAGE (S) 33 AC-FT

ELEV	AREA	W.P.	R	$R^{2/3}$	$S^{1/2}$	$1.49/n$	Q	LENGTH
155	625	150	4.167	2.59	.055	23.72	2626	5'
160	1500	200	7.50	3.83	.055	23.72	3439	5
152	210	110	1.91	1.54	.055	23.72	529	8'



$V_1 = \frac{6+3.7}{2} \times \left(\frac{190+120}{2} \times 1000 \div 43{,}560\right) \times 1/2 =$ 7.2 AC-FT

$Q_{P2} = Q_{P1}(1 - V_1/V_2) =$ 1376 cfs

$V_2 = \frac{6+3.7}{2} \times \left(\frac{190+120}{2} \times 1000 \div 43560\right) \times 1/2 =$ 7.0 AC-FT V = 7.1 AC-FT

$Q_{P2} = Q_{P1}(1 - V_1/V_2)$ 1383 cfs

STAGE DISCHARGE: 1393 cfs ELEV 153.4 DEPTH = 3.4 ft

NEXT DOWNSTREAM SECTION: 1/2 ft

BY ERJ DATE 1/15/80

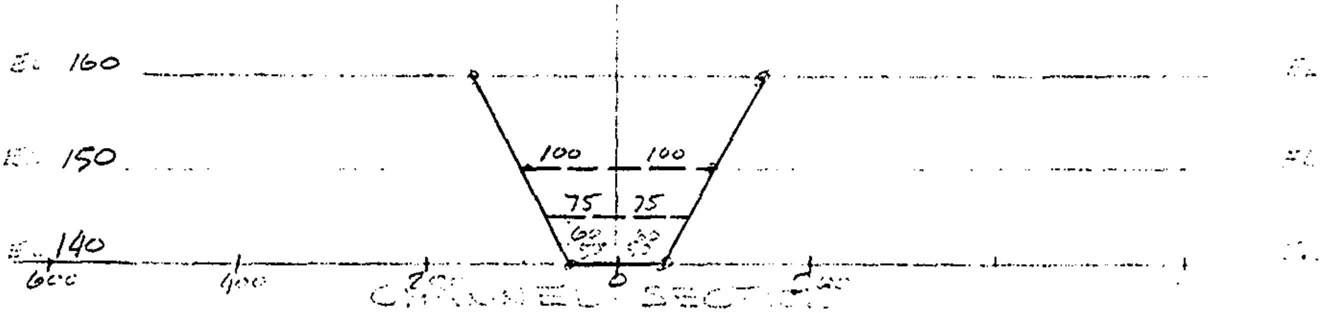
DOWNSTREAM W.S. EL. COMPUTATION

NAME OF DAM: [illegible]

SECTION LOCATION 5000' DOWNSTREAM FROM DAM

USING: $Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

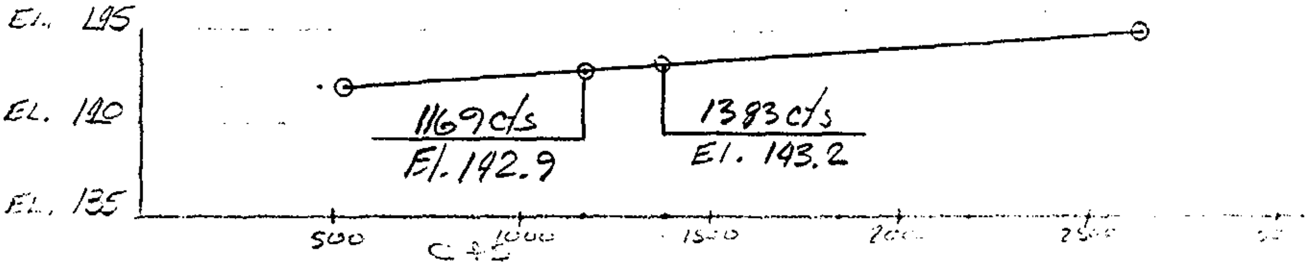
WHERE: n = 0.05   S = SLOPE = .0031 ft/ft



CHANNEL SECTION

QP = 1383 cfs   STORAGE (S) 33 AC-FT

ELEV	AREA	WP	R	$R^{2/3}$	$S^{1/2}$	1.486/n	Q	DEPTH
142	220	120	1.833	1.50	.055	[illegible]	540	2'
145	625	150	4.17	2.59	.055	29.72	2346	5'
						29.72		



$V_1 = \frac{3.4+3.2}{2} \times (140+130 \times 1000 \div 43{,}560)$ ½ = 5.1 AC-FT

$Q_{P2} = Q_{P1}(1 - V_1/S)$ = 1169 cfs

$V_2 = \frac{3.4+2.9}{2} \times 3.1 \times \frac{1}{2}$ 4.9 AC-FT   V = 5.0

$Q_{P2} = Q_{P1}(1 - V_{avg}/S)$ = 1173 cfs

D-23 STAGE DISCHARGE 1173 cfs ELEV 142.9 DEPTH 2.9

NEXT DOWNSTREAM SECTION @ [illegible]

Surface Area [illegible] $.15^{0} \times 2000^{2}/43560$ = 12.3 Ac

33 [illegible] = 2.9'

RATING CURVE DEVELOPMENT

Middle Reservoir Dam

Spillways

$$Q = C\ L\ H^{3/2}$$

$C = 2.7$

$L = 29$ feet (primary)
12 feet (auxiliary)

24 Inch Pipe

$$Q = c\ a\ (2gh)^{1/2}$$

$c = .6$

$a = 3.14$ square feet

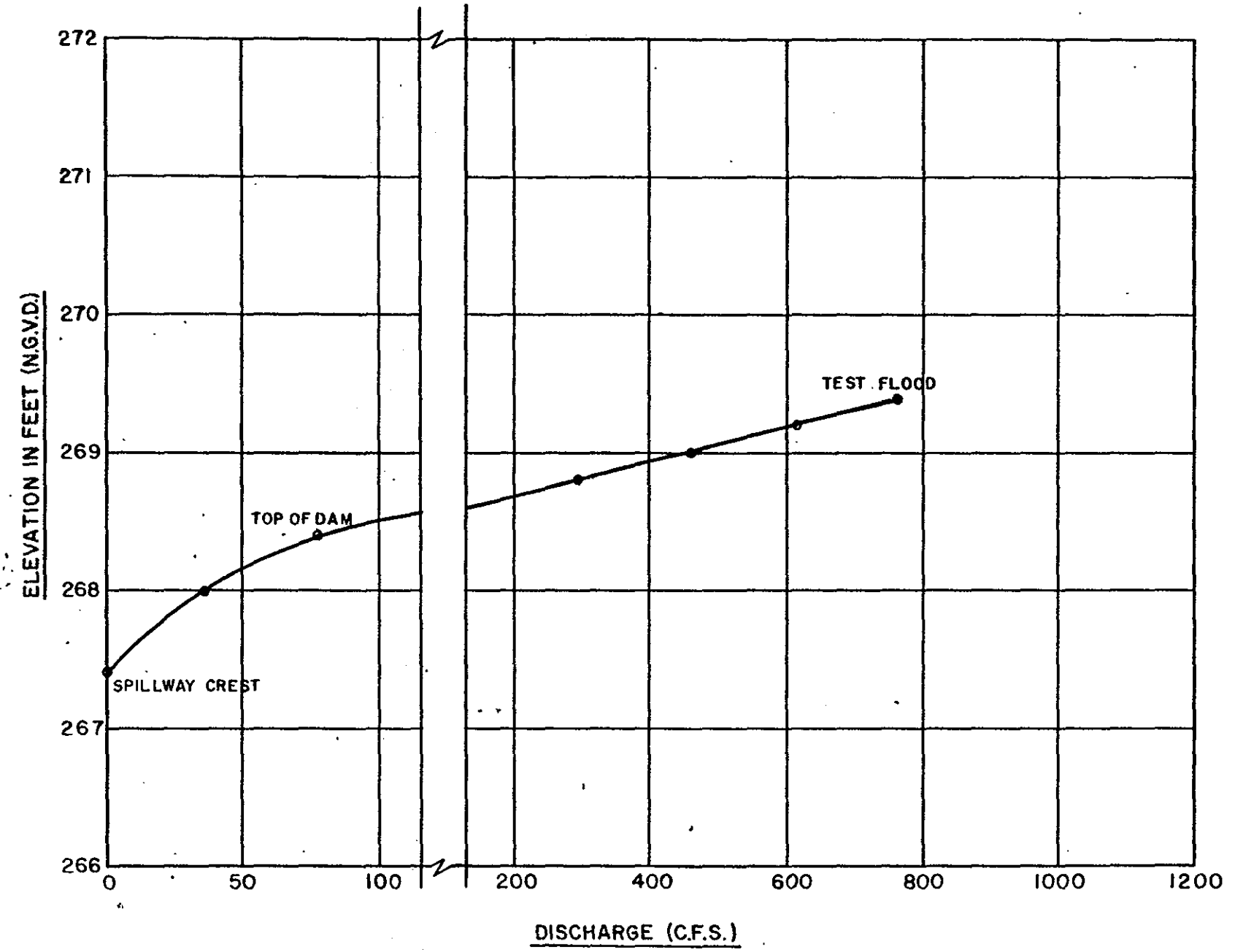
8 Inch Blowoff

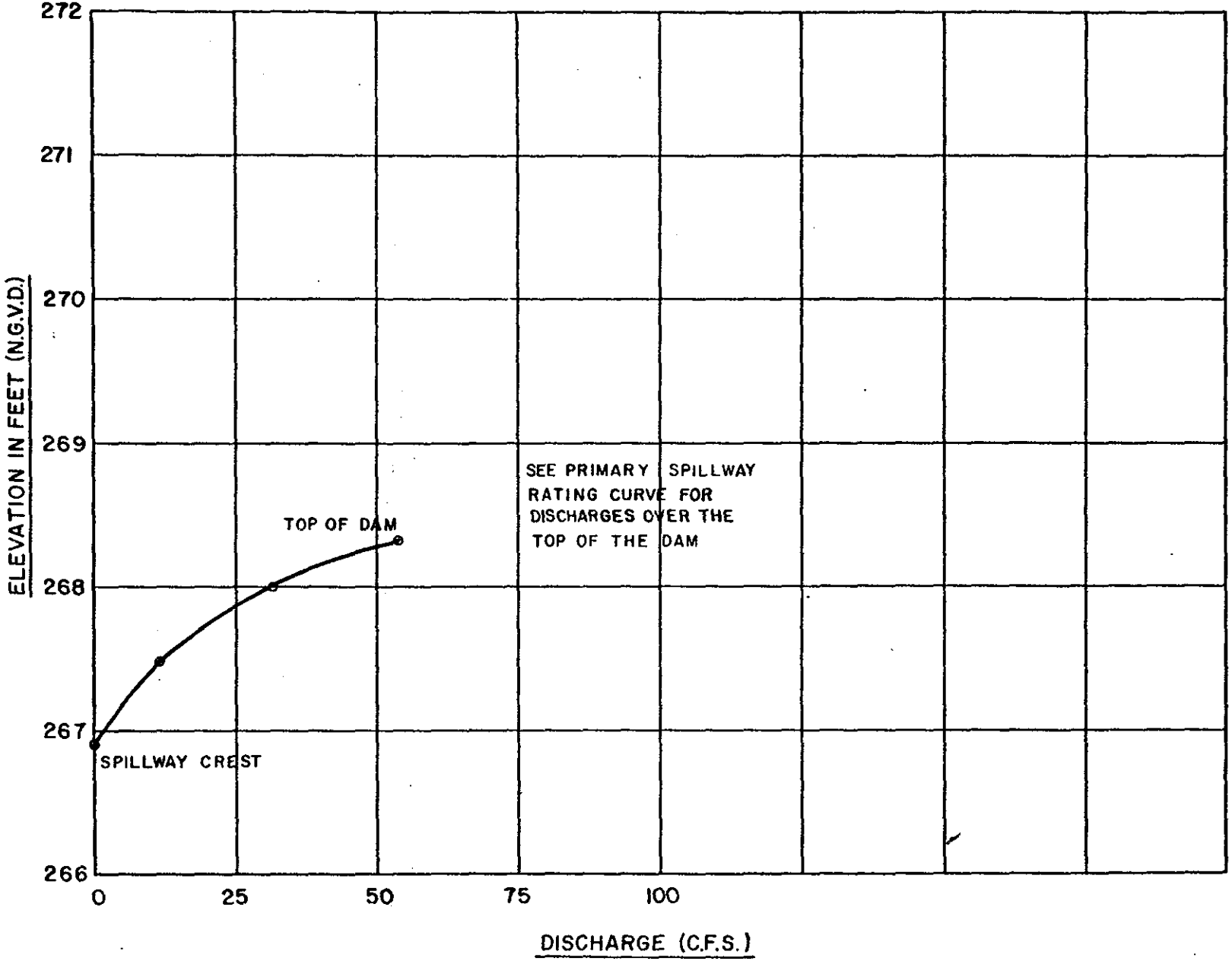
$$Q = c\ a\ (2gh)^{1/2}$$

$c = .6$

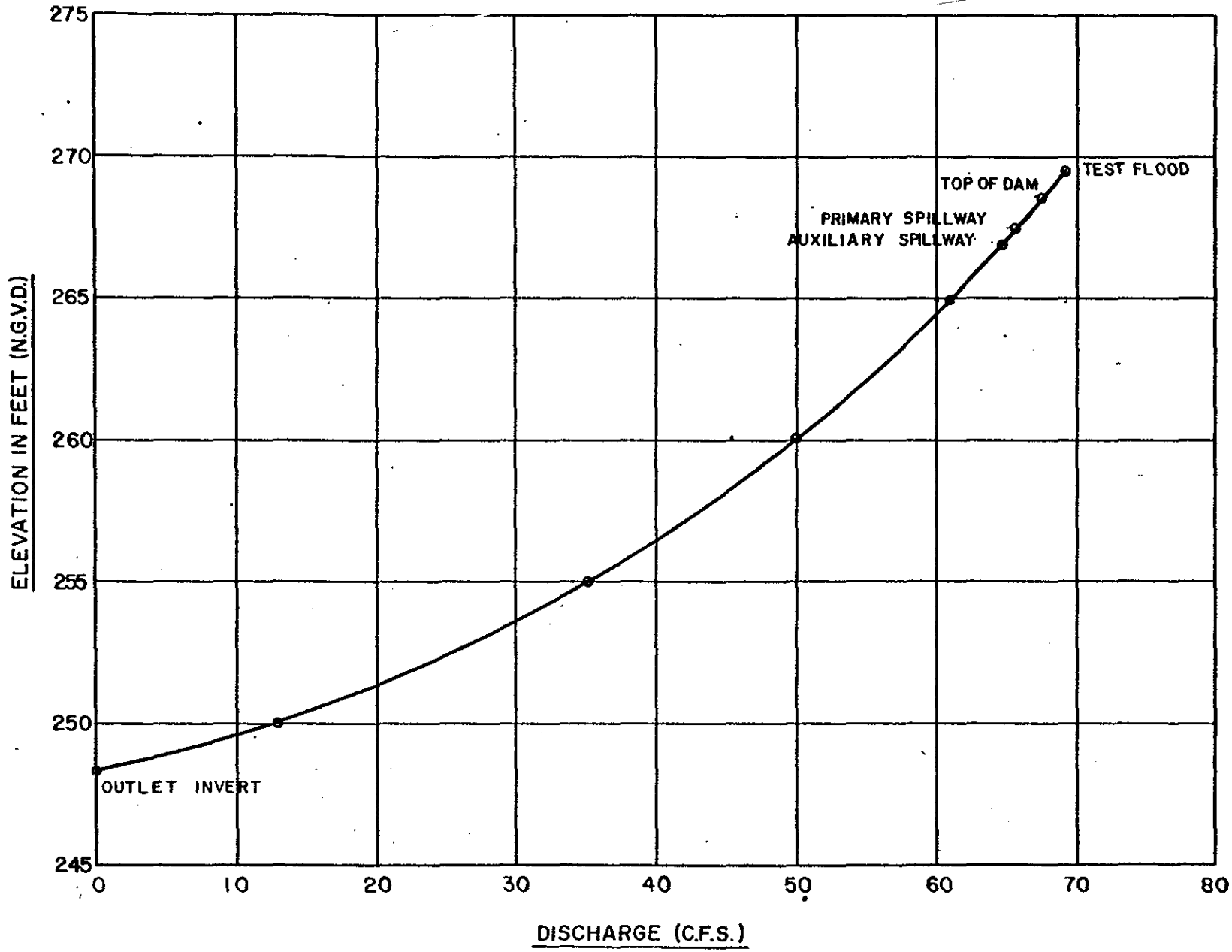
$a = .35$ square feet

MIDDLE RESERVOIR DAM
PRIMARY SPILLWAY RATING CURVE





MIDDLE RESERVOIR DAM
AUXILIARY SPILLWAY RATING CURVE
D-26



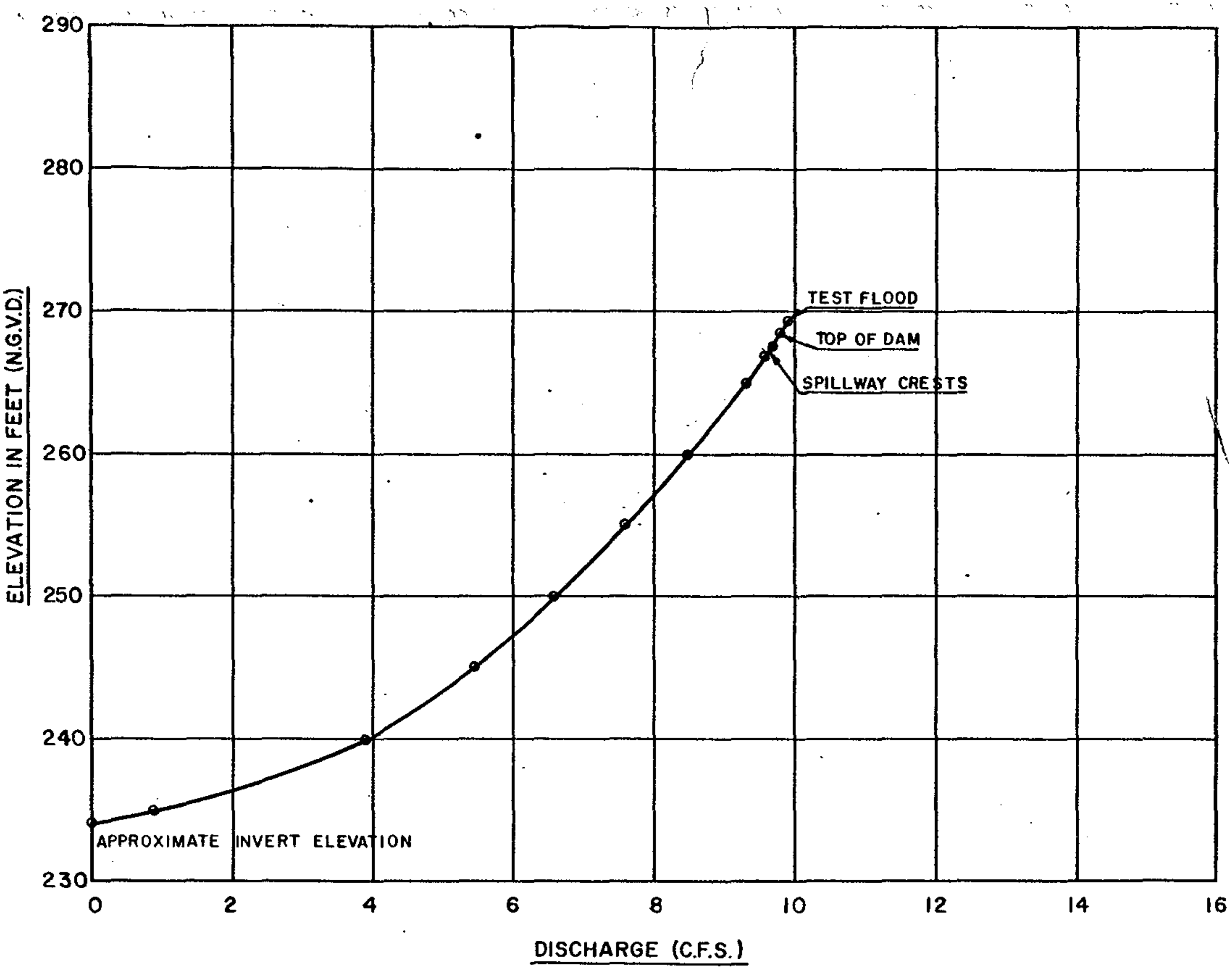
MIDDLE RESERVOIR DAM

24. INCH PIPE

OUTLET WORKS RATING CURVE

D-27

MIDDLE RESERVOIR DAM
8 INCH BLOWOFF
OUTLET WORKS RATING CURVE



E

APPENDIX E

INFORMATION AS CONTAINED IN THE

NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME